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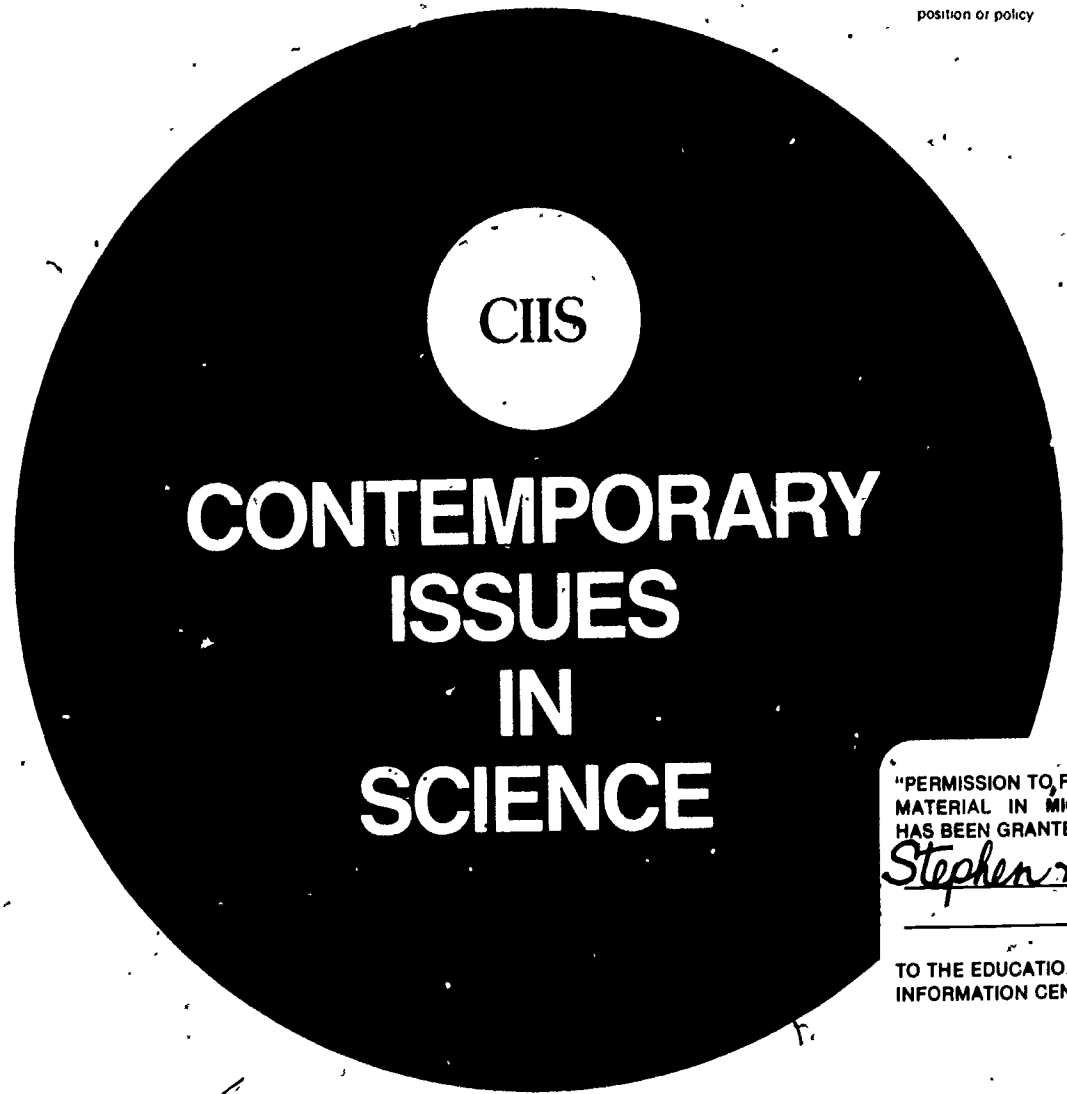
ABSTRACT

Contemporary Issues in Science Program (CIIS) is designed to provide teachers and students with the necessary tools and strategies for bringing contemporary scientific issues into the classroom. Provided in this document are discussions of the three major elements in the program, support elements, and major activities. Major elements include the research paper and class discussions, lectures, and forum. Support elements include the advisory group, resource center, paper reviews, and community involvement. Strategies and examples related to each element are provided. In addition, suggestions related to use of the program in business education/industrial arts, career education/internships, and in interdisciplinary studies are provided. An overview, background information, questions, references, teacher notes, and vocabulary are provided for each of 11 issues presented in an appendix. Issues include acid rain, radioactive wastes, hazardous wastes, Love Canal, aquifers, cloning, recombinant DNA, organ transplants, laetrile, genetic counseling, and birth control. Provided in a second appendix are selected resources, including organizations, periodicals, audiovisual materials, and speaker directories. (JN)

IMPLEMENTATION MANUAL



CONTEMPORARY ISSUES IN SCIENCE

Implementation Manual

Contemporary Issues in Science
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Anyone wishing to contribute comments or suggestions on the contents of this *Implementation Manual* is encouraged to write to: Contemporary Issues in Science, c/o Staten Island Continuum of Education, Inc., 130 Stuyvesant Place, Room 704, Staten Island, New York 10301.

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PROGRAM OVERVIEW

A. *Introduction*

The average citizen today can no longer ignore the rapid technological advances that have enveloped every aspect of our modern society. Newspapers are filled with stories on recombinant DNA, nuclear energy, toxic waste disposal, and computers. These same technologies are having a significant impact on our modes of behavior and lifestyles.

Students are also becoming more aware that technological advances are real and have implications that will affect their personal lives. A lesson on radioactivity invariably leads to a discussion of nuclear power plants and their safety.

A discussion of human reproduction raises questions about invitro fertilization, cloning, artificial insemination, and sex preselection technologies. Even the chemistry laboratory is riddled with safety precautions on the use and disposal of hazardous materials.

The implication for the science teacher is clear. Science only becomes real and germane to students when they have the opportunity to think and work rationally with issues such as recombinant DNA, acid rain, and food additives. Social awareness must be an integral component in science teaching.

Students should:

1. Understand not only the content and process of science, but also the social ramifications; and,
2. Recognize that objective analysis, rational thought, and value judgments contributed to informed decision making.

B. *Teacher Preparation*

The current nature of science issues and the rapidly expanding base of information have made it exceedingly difficult for the teacher to understand all the ramifications of issues such as nuclear energy and recombinant DNA. As a partial answer to this problem, this manual contains numerous descriptions of issues that can be duplicated for discussion in class, key questions for discussion, and select references to

provide a background for further study. In addition, certain publications contain information on current issues. Publications such as *Science*, *Science 82*, *Scientific American*, and *The Hastings Center Report*, contain information on current issues. These can provide the teacher with the necessary background to guide discussions of these issues. Several additional publications are listed in Appendix II.

C. *Contemporary Issues in Science Program* (CIIS)

The difficulty in addressing the need to include contemporary issues in the science curriculum is two-fold: the teaching required to cover the content areas of mandated syllabi leaves little if any room for application of science principles to current issues; and, the interdisciplinary nature of these issues requires that students have special skills in research, writing, problem analysis, and decision making, all based on an understanding of the political and social factors involved. This represents a difficult task for both the student and the teacher.

CIIS will provide both the teacher and the student with the necessary tools and strategies for bringing contemporary scientific issues into the classroom. Teachers may elect to use only parts of the program as an enrichment component in existing science curricula or it may be used in many classes within a school or across schools within a district. In schools which find the need to offer separate elective courses based on the program, the separate course guide will provide the information and background.

D. *Program Elements*

Each of the following program elements will be explained more fully in subsequent sections in this manual. The following listing will provide a brief description of each part.

The Major Elements in the Program Are:

1. *Research Paper and Class Discussions* (Section I)

   - Students prepare research papers on selected issues that are provided in this manual (Appendix I.) Suggested reference materials are provided, and guidelines for researching and writing papers are included in a separate manual.
   - Specific issues for class discussion are keyed to topics in biology, chemistry, and physics.

2. *Lectures* (Section II)

   - Experts in specialized fields directly related to the students' research provide students with additional perspectives on the issues.

3. *Forum* (Section III)

   - At the conclusion of the research, class discussion and lectures, students meet for group discussions of the issues with other students, scientists, and community members. This special gathering is called the forum.

The Major Support Elements Are:

1. *Advisory Groups* (Section IV)

   - Although topics for research papers can be selected from the sample issues presented in this manual, an advisory board can be established to help in the selection of topics for research discussion.

2. *Resource Center* (Section V)

   - Specialized reference materials that address the specific issues of research and discussion can be established within the school library or in a central location within the school or a local college.

3. *Paper Reviews* (Section VI)

   - Once the research papers are submitted by the students, they may be reviewed by a group of English teachers for technical evaluation.
   - It is most effective to have the papers reviewed by both English teachers and scientists in the field. Scientists comment on the paper content, establishing a dialogue with the student.

4. *Community Involvement* (Section VII)

   - Many local industries, organizations, and parent groups support the student activities by a direct participation in the forum and serve as a resource for student research.

Option for CIIS

1. *Business Education/Industrial Arts* (Section VIII)

   - Students within the stenography and typing classes may be involved in recording and transcribing the discussions both in the science class and at the forum.
   - A business education class may assist science students in the preparation of a final booklet of proceedings from the forum. In cooperation with industrial arts classes, a printed booklet can be prepared.

2. *Internship/Career Education* (Section IX)

- Various industries, government agencies, and community organizations can provide summer internships that relate directly to the issue being researched and discussed by students.
- Examples of careers in the field of science, government, and public policy can be included in the discussions of technological issues. Guest speakers can provide students with an overview of career potentials. Some are listed in Appendix II.

3. *Interdisciplinary Approach* (Section X)

- Social studies classes can be involved in CIIS along with the science classes.

MAJOR ELEMENTS	*SUPPORT ELEMENTS*	*OPTION*
a. Research Paper	a. Advisory Group for topic selection	a. Business Education Industrial Arts
b. Class Discussion	b. Resource Center	b. Internships/Career Education
c. Lectures	c. Review of Student Papers	c. Interdisciplinary Approach
d. Forum	d. Community Involvement	

Fig. 1. Program elements. Each of the elements is fully described in the appropriate sections of this manual.

E. *Selecting the Approach*

The various parts of CIIS were designed to be added at a pace which fits the needs of individual classes or schools. For example, the research paper and class discussions may be used as part of the curriculum in an existing biology, chemistry, or physics class. The lectures and forum activities can be added in a subsequent year. As your experience with the program grows, the support elements and various options can be added. In order to bring students to an understanding of the interdisciplinary nature of technological issues, all major elements of the program should be the minimum goal.

A more effective design would include two or more classes within the same school with students researching and discussing the same issues. This allows students to share ideas with students from other classes, and makes the nature of complex social issues more real. It also provides a more varied perspective on those issues, especially at the forum.

The most effective approach would involve classes from different schools. This requires a coordinated effort among teachers and supervisors from the various schools. When experts and community members are invited to participate in the

culminating forum, the students begin to understand the need for broad-based input on those issues.

F. *Organization for Multiple Classes/Schools*

If the CIIS is used in multiple classes or schools, the coordination of the efforts of teachers and supervisors becomes important. Students in all classes must be provided with the same issues for research, and a rigid timetable both for students and teachers must be established. Students from different classes must attend the same lectures and must work together in preparation for the forum. It is appropriate that a coordinator be assigned to decide on a timetable, invite guest speakers to a central location, arrange for meeting places in preparation for the forum and coordinate the activities at the forum. A sample timetable is presented in Fig. 2. This is flexible and should be adapted to fit individual needs.

September	○ Selection of topics for research ○ Students begin research ○ Class discussions
October	○ First lecture ○ Students submit preliminary bibliography ○ Class discussions
November	○ Second lecture ○ Students submit additional references ○ Class discussions
December	○ Third lecture ○ Students submit first draft of their paper ○ Class discussions
January	○ Students submit final paper ○ Class discussions
February	○ Fourth lecture ○ Students' papers are returned ○ Class discussions
March	○ First meeting of students in preparation for the forum ○ Class activities including preparation of posters, bulletin boards, etc. ○ Class discussions
April	○ Second meeting of students in preparation for forum ○ Invitations sent to community and scientists ○ Class discussions

Fig. 2. One example of a timetable for coordinating activities of multiple classes and schools.

As the support elements in the program are included, these too should become part of the timetable. Students must know when and what is expected.

G. *CIIS As an Elective Course*

Many schools find the need for a more formal curriculum that deals directly with the issue of science and society. When time commitments allow for inclusion of such an elective, the curriculum guide "Contemporary Issues in Science: Course Manual" will provide details for the full year course and can be used in conjunction with the research—lecture—forum sequence.

H. *How To Use This Manual*

The remainder of this manual contains descriptions of the three major elements in the program, support elements, and major activities. Each section will suggest strategies for its use with specific examples. The titles below can serve as a guide.

SECTION I: RESEARCH PAPER AND CLASS DISCUSSIONS

ASSIGNMENT OF TOPICS

The group of issues (Appendix I) with key questions and references can serve as a source of topics for student research papers. If the teacher wishes to deal with more local issues, or the selections are inappropriate, an advisory board can be established to help in the selection process. This is explained more fully in Section IV. It is recommended that classes be given four different topics from which a student will select one topic for research. The different topics should be evenly distributed among the students. The same procedure applies to multiple class/school programs wherein all classes or schools are addressing the same three or four issues.

It is further suggested that the topics fit a broad theme, such as Hazardous Waste. This selection of topics provides students with various perspectives on the theme. It also provides for interesting discussions among students who have selected different topics, yet have an established common ground.

Prior to formal assignment of topics, each of the selected issues should be discussed in class so that students understand the issues and what the research entails. One technique that has proven successful is the use of current newspaper or magazine articles directly related to the issues. This can serve as a motivation for discussion and will aid students in selecting their topic.

WRITING THE PAPER

This is the area with which students experience the most difficulty. One of the major reasons for this difficulty is the self-discipline required of students in researching and writing a paper. Most students respond favorably to a rigid timetable with targeted milestones and constant monitoring by the teacher. For example, students might be required to submit index cards of references they have located within the first month. They may then be required to submit an outline, a first draft, and a final draft of their paper by specified dates. This "Contract" approach with constant teacher monitoring and input gives students the needed structures.

A second area of difficulty is in the actual writing of the paper. Students should be encouraged to use the *Writing Manual* as their guide. It contains many useful sugges-

tions and gives specific examples and recommendations for writing. It also contains suggestions for class activities that will highlight research and writing skills.

Students also find it difficult to "get started". The topics listed in Appendix I include suggested references which will help students gain a further understanding of the issue and provide starting points for their research. Students should be encouraged to bring research articles to class. This serves further to motivate students and helps to increase the reference pool for the class.

Some Suggestions:

- Students should be encouraged to write to authors for additional information. Responses can be presented to the class and discussed. This is a strong motivational tool.
- Students might be required to conclude this research paper with a copy of a letter that the student is required to send to a government agency, official, legislator, special interest group, industry, or scientist stating one specific recommendation the student can make based on his research. Responses to the letter might serve as a basis for class discussion. This makes the student's work a real and concrete part of his experience.
- Students should be encouraged to make personal contact and interviews with persons directly involved in the issue. For example, an interview with a kidney donor would be appropriate for the issue of Ethics and Transplantation and can serve as the basis for class discussion. This makes the issue a real and meaningful experience for students.
- Scientific articles or government publications can be difficult for students. Teachers should spend some class time in reviewing some of the techniques for reading these articles and reports. Useful suggestions are in the *Writing Manual*. Teachers might also provide copies of articles for class discussion.
- Students frequently have difficulty in interpreting graphs, tables and charts. Transparencies of different figures should be presented to the class so that students can learn some basic skills in data interpretation.
- Librarians are helpful in presenting a library lesson on basic library skills, including those of card catalogues, indexes, reference materials, skimming and scanning, and use of all resource materials.

CLASS DISCUSSIONS

Many examples of issues that can be used as the basis for class discussion are presented in Appendix I. These can be reproduced for students and discussed at appropriate places within the biology, chemistry, or physics curriculum. The teacher should use many of the questions that are given. These reflect the many facets of current issues, and encourage the students to think about the scientific basis of the issues as well as the economic, political, social and ethical ramifications. In addition to the questions, refer-

ences are provided for each. In all cases, however, the teacher should be cautious about presenting his own views. Students should begin to formulate their own ideas based on an objective analysis of the issues. *The teachers' questioning techniques should be designed to make students aware of the many facets of an issue, not to provide answers.*

Some Suggestions:

- Current articles related to the topics of research should be brought in on a weekly basis for discussion. This may involve only 5–10 minutes of class time, but it helps students to understand and experience the current nature and widespread impact of the issues.
- Students should be encouraged to bring current articles to class. A five minute discussion, or at least an announcement in the class is motivating.

SECTION II: LECTURES

The use of outside experts in supporting the student research is necessary to provide the broad-based and varied perspectives on multi-faceted issues. Speakers should be selected to provide a balanced overview of the issues. Before speakers are invited to address the students, the teachers should be certain that the talk will be pertinent, relevant, and focus on the many factors involved in the topic. In addition, many speakers appreciate being informed on the scope of the program and the reason for their talk. Remind speakers that the students are at the secondary level.

Some Suggestions:

- Arrangements should be made to have students from different classes or schools meet the speaker at one central location. This provides additional opportunities for students to share their ideas.
- Lectures should be scheduled for each of the topics. Four topics would require four lectures.
- The community and other classes or teachers not directly involved in the program should be invited to attend. Flyers announcing the lectures might be prepared and posted.
- Students should be informed well in advance of the scheduled lectures which should be timed to coincide with the progress of student research.
- Students might be required to prepare one or two questions in advance of the lecture. This enhances the interaction of expert and student, and helps to focus student attention on the issue. Students might also be required to prepare a summary report on the lecture which can be discussed in class.
- It is helpful to assign students to various roles. Students might be used to introduce the speaker or moderate the program. This enhances their communication skills.

The availability of speakers for select issues is widespread. Teachers may contact local college or universities, local industries such as power companies, special interest organizations, local scientific institutions, and government agencies, such as "The Communicators" (a directory of energy related speakers and contacts for the public and the media published by the Public Information Department of the American Nuclear Society). Some additional sources for speakers are found in Appendix II.

SECTION III: FORUM

OVERVIEW

The forum is a one day gathering of all students and teachers in the program as well as invited guests, including other students, teachers, scientists and community members. The forum is structured to provide the means for students to use their research and information in discussions with other students and the community. Students will moderate the program, participate in small group discussions with other students and the community, present abstracts of the issues involved, and present recommendations on various issues. The forum represents a culminating activity in which students will begin to test some of their ideas and recommendations in the real world. It also allows the community, including various scientists and experts to participate and share their ideas with the students. Since the forum is student oriented, they receive an invaluable experience in communicating with the community.

FORUM PROGRAM

> NOTE: The various elements as described below are intended as guidelines. Teachers may elect to select only some of the elements. For example, the forum may be an informal gathering of all students in the program, and discussions may be limited to a few key questions.

Although the actual forum can be modified to fit various time schedules, number of participants, and existing facilities, the forum should include a student as a moderator, followed by brief descriptions of the issues presented by students. A student should also serve as the keynote speaker for the forum. This part of the program should not take more than 30 minutes.

Following this general session, all participants in the forum, including students, parents, scientists, educators, and other community members meet in pre-assigned panels. These panels should have a maximum of thirteen to fifteen participants and should continue for approximately one hour and 30 minutes. The number of panels is determined by the number of participants and topics. At the conclusion of the panel discussions, students present the recommendations from each of the panels to the entire forum, and the program is ended.

A sample of the program is shown below. Based on student attentiveness and capabilities, participant interaction, and ability to meet all objectives of the forum, the timing of an actual program (below) should be followed.

SIXTH ANNUAL SCIENCE FORUM
WAGNER COLLEGE
May 8, 1982

9:30-10:00	REGISTRATION FOR PANELS Communications Building—First Floor Coffee and donuts will be served courtesy of the parents of Susan E. Wagner High School, New Dorp High School, St. Joseph Hill Academy, Port Richmond High School, Staten Island Academy, Curtis High School, and Tottenville High School
10:00—10:30	GENERAL SESSION
Welcome:	Christine Vento Forum Moderator St. Joseph Hill Academy
Greetings:	Dr. Sam H. Frank President Wagner College
Keynote Speaker:	Rebecca Fisk Susan E. Wagner High School
Addresses:	AQUIFERS Mary G. Robinson St. Joseph Hill Academy
	RADIOACTIVE WASTE William Bifulco Staten Island Academy
	DISPOSAL OF HAZARDOUS WASTE Joshua Friedlander New Dorp High School
	ACID RAIN Jean Marie Kerney St. Joseph Hill Academy
	LOVE CANAL Debra Friedman Susan E. Wagner High School
10:30—10:40	INTERMISSION
10:40—12:25	PANEL DISCUSSIONS Communications Building—First and Second Floors
12:25—12:45	INTERMISSION
12:45—1:05 Forum Commentators	PANEL RECOMMENDATIONS Beth Ann Banks (Aquifers) Michele Traboscia (Love Canal) Steven Tabak (Disposal of Hazardous Waste) Eugene Sorenson (Acid Rain) Amy Goldman (Radioactive Waste)
1.15—2:30	LUNCHEON Student Union Courtesy of Monsanto Fund, Power Authority of the State of New York, Brooklyn Union Gas Company, Con Edison, The Italian-American Institute to Foster Higher Education, and the Staten Island Continuum.

FORUM PLACEMENT

The forum should be scheduled at a time in the school year when students have completed their research, attended all scheduled lectures, and have had time to discuss the issues and prepare for the forum. This generally occurs in late April or early May. In addition, the forum should be held in a setting outside the school. Colleges and universities are quite helpful and willing to offer their facilities. Frequently higher education institutions will suggest faculty members who would participate in the forum, especially if it is held on a Saturday.

PREPARATION FOR THE FORUM

The timing, coordination, and structure of the preparation work for the forum program are critical to its successs. There are four areas that must be carefully structured: student preparation; assigning students and the community to panels; assigning roles to students; and inviting community participation.

A. *Student Preparation.*

Students should be given ample opportunity to discuss their research topics with each other. This becomes important when students from different schools or classes are involved in the same research topic. The most effective preparation is to place students together within the same research topic, and assist them to identify key questions and discuss them. When multiple classes or schools are involved, this provides a means for students to meet each other and to gain new perspectives on the issue. It allows them to discuss ways in which the panel discussions at the forum should be organized. Students should also be encouraged to bring copies of their research papers, copies of articles, and notes to the forum to support their discussions. In addition, some students might be assigned to prepare posters and other materials which can be displayed at the forum.

B. *Organizing Panels.*

The number of panels and participants on each panel on the day of the forum is determined by the number of issues or topics. For example, if the general theme of the program is Risk/Benefit Assessment, and students have been studying and researching any one of four specific issues (eg. human experimentation, nuclear energy, carcinogens, or solid waste disposal), the minumum number of panels would

be four—one for each topic. As the number of students researching a particular topic increases, the number of panels for that topic must be increased.

Some Suggestions:

- Students from different classes or schools with the same research topic should be placed on the same panel.
- There should be a minimum of six students and a maximum of ten students on each panel.
- Community participation in the panel discussions, including parents, scientists and educators should be designed to provide students with maximum and varied input.
- Panels should be limited to 13–15 participants.

A sample of panels from an actual program is shown below.

PANEL DISCUSSIONS

10:40—12:25

First and Second Floor
Communications Building (CB)

Aquifers

Panel AQ1 **CB 2** **Room 22**

Chair: Beth Boyle
Port Richmond High School
Co-Chair: Denise Monte
St. Joseph Hill Academy
Commentator: Dominick Lobraico
New Dorp High School
Recorder: Ellen McCarthy
St. Joseph Hill Academy
Panelists: Beth Ann Banks
Mark DeMauro
Andrew Koren
Ellen Schroeder
Participants: Sister Maura Hyland
Rebecca S. Thomson
Lorraine Zimmerman

Aquifers

Panel AQ2 **CB 2** **Room 23**

Chair: Valerie Rice
Susan E. Wagner High School
Co-Chair: William Lee
Staten Island Academy
Commentator: Anne Cucco
St. Joseph Hill Academy
Recorder: Eileen Devenney
St. Joseph Hill Academy
Panelists: Lucy Napolitano
Mary Robinson
Debroah Sarlls
Alicia Sisk
Participants: Mark Flamendorf
Michael Mahmet
Michael Torrusio

Acid Rain

Panel AR1 **CB 2** **Room 24**

Chair: Leslie Frazier
Curtis High School
Co-Chair: Dorothy Cernera
Susan E. Wagner High School
Commentator: Cynthia Caracta
St. Joseph Hill Academy
Recorder: Cheryl Gottesfeld
Port Richmond High School
Panelists: Laura Conigatti
Launne DeLuca
Marie Johnson
Jeannemarie Kearney
Geraldine Price
Yuk-Ting Wu
Randa Zagzoug
Participants: Garbrielle Edwards
Robert Frankel
Vincent Gattullo
Dr. August Goldin
James Regan
Mary Regan

Acid Rain

Panel AR2 **CB 2** **Room 25**

Chair: Anatol Rowland
Tottenville High School
Co-Chair: Michael Conroy
Staten Island Academy
Commentator: Laura Fox
Port Richmond High School
Recorder: Judy Weeks
Curtis High School
Panelists: Jeanne Bennett
Ken Dulski
Peter Farrell
Charles Frankel
Brigitte Korda
Anne Nestor-Hubert
Roberta Trainor
Participants: Fran Calamera
Betty Darcy
Dr. Harris Goldberg
Frances Lee
Erika G. Monte

C. *Assigning Roles*

The forum is most effective if students are provided with a structure which identifies specific roles for each student participating in the program. The roles listed below are suggestions which can be readily modified to fit individual needs. They are intended as guidelines only.

1. Forum Roles—General Session

Select students may be assigned to moderate, serve as keynote speaker, present one or two minute abstracts of each issue and present panel recommendations to the forum. It is important to provide these students with guidelines for their various roles. All student speakers should be careful to present a balanced point of view.

FORUM MODERATOR

FUNCTION: To control the movement of the entire forum.

Guidelines for the Forum Moderator:

a. Welcome Address:
   - Who you are and the school you attend.
   - Special thanks to sponsors.
   - A few words about why everyone is present and the importance of this dialogue.

b. *Introduction of the Keynote, Guest, and Forum Speakers:*
   The moderator should introduce the speakers one at a time by name, position, school and topic.

c. *Direct Audience to the Assigned Rooms:*
   After speakers have completed their talks, the audience must be directed to their assigned rooms for panel discussions. Advise the audience of the time to return to the forum room after the conclusion of the panel.

d. *Introduction of Forum Commentators:*
   After the panels have returned to the forum room, introduce each Forum Commentator. Explain to the audience that the Forum Commentators will present summaries of all the panel recommendations within each topic which were prepared during the intermission after the panels ended.

e. *Conclusion:*
   - Remind the audience to place questionnaires and worksheets in the boxes provided.
   - Thank all participants in the forum.

KEYNOTE SPEAKER

FUNCTION: To present a speech to the general forum highlighting the principal issues that will be discussed.

Guidelines for Keynote Speaker:

a. Meet with panel chairmen at least two weeks before the forum to get an overview of what each issue covers.
b. Prepare a two minute speech (approximately 500 words) that includes a motivating introduction and highlights the issues which will be discussed. Do not get too specific since forum speakers will follow.
c. Present your speech to the directors for approval at least one week before the forum.
d. Speak slowly and clearly using pauses and eye contact for effect.

FORUM SPEAKERS

FUNCTION: To raise the questions of their issue and suggest what the panels should examine. These should represent neither a personal viewpoint nor a criticism of others.

Guidelines for Forum Speakers:

a. Meet with the members of your assigned panel and discuss the main issues that will be reviewed. Get a consensus and prepare a speech to cover these points.
b. The address will be exactly two minutes (approximately 500 words) and start with an attention getting interesting introduction.
c. Present the speech to the directors at least one week before the forum for approval.
d. Speak slowly and clearly, using notes if necessary, and maintain eye contact.
e. Pause after important statements to allow for audience assimilation and emphasis.

FORUM COMMENTATORS

FUNCTION: To compile all the recommendations of the respective panels and produce one list to present to the forum.

Guidelines for Forum Commentators:

a. Directly after the panels end, meet with panel commentators for your topic in designated locations.

b. Each panel commentator will have his or her own list of recommendations which the Forum Commentator will compile into one separate list.

c. Be careful not to repeat recommendations.

d. Simplify recommendations so they can be presented as statements.

e. Note and explain any disagreements between panels.

f. The Forum Commentators must be in the main forum lecture room twenty minutes after the end of the panel discussions, prepared to report to the forum the compiled list of recommendations. You will be introduced by the forum moderator and have exactly two minutes to report. Identify yourself as "Forum Commentator" for topic . . . . . "

g. Speak slowly and clearly using pauses and eye contact to emphasize your statements.

2. Forum Panels and Panel Roles

The forum panel provides for the discussion of a particular issue or case study by a selected group of people. It is comprised of students in the forum program who have thoroughly researched the issue of the panel, invited knowledgeable guests, and the general public who are expected to participate by adding their expertise to the answering of pivotal questions pertaining to the issues that will result in recommendations for future study.

Panel Roles

The forum is most effective if the student and invited panelists are provided with a structure which identifies the specific roles of each. The roles listed below are suggestions which can be readily modified to fit individual needs. They are intended as guidelines only.

STUDENT PANELISTS

Student panelists are students who are part of the forum program and have researched their chosen area of concern. They have produced a documented research paper that has been developed under teacher supervision along the lines of the *Writing Manual* procedures. The students have developed a broad knowledge of their case studies and should be familiar with their own work.

Each student panelist, including those who have an additional function, will take two minutes (approximately 500 words) at the beginning of the panel to discuss the topic, procedures, findings and conclusions of his research. This discussion will delineate areas of student strength and highlight their individual research.

All students will be expected to participate in the discussion of the pivotal questions and assist in the formulation of recommendations for future study. In the discussion, it is desirable for the student to cite specific references which he has accumulated and to use index cards to recall specific facts.

Some student panelists will be assigned to perform an additional administrative function to insure flow, clarity and note taking of recommendations for the larger forum at the conclusion of the panel.

PANEL CHAIRPERSON AND CO-CHAIRPERSON

FUNCTION: The chairperson is responsible for the welcome, introduction, movement, direction and progress of the panel. He or she should offer the predetermined pivotal questions, moderate discussion, call on volunteer panelists and assist in every way.

Guidelines for Panel Chairperson and Co-Chairperson:

a. Meet with your co-chairperson beforehand and clarify your role and how it will be shared.

b. Provide for a welcome that includes:
   - Name of panel
   - Introduction of student and guest panelists.
   - Introduction of chairperson, co-chairperson, recorder and commentator

c. Provide an understanding of the function of the panel. Include:
   - Definition of a panel
   - Composition of the panel — students and guests
   - The procedure the panel will use — a discussion of pivotal questions through research papers and developed expertise — will result in recommendations for future study.
   - Pause for questions

d. Have each *student panelist* including those with additional duties give a two minute presentation that discusses the topic, procedures, findings and conclusions of his particular research paper. This should familiarize all panelists with the scope of the research and establish a starting place.

e. Read the first pivotal question to the entire panel and generate discussion using the student researchers and guests. You must insure that:
   - All panelists are given the opportunity to speak if they wish.
   - Only one person speaks at one time. Do not allow one person to *monopolize* the conversation.

- The discussion does not stray from the topic.
- A consensus of opinion develops after a reasonable time and recommendations are set before going on to the next question. Depending upon the situation, about fifteen minutes per question is normally sufficient. The chairperson accomplishes this either by calling upon the Panel Commentator when discussion ends or by concluding the discussion himself when the allotted time for the question elapses.

f. Continue to discuss each pivotal question in the same way with chairpersons sharing the responsibilities.

g. Make note of the time and conclude when the allocated time expires.

h. Make any concluding statements and thank all participants. Direct everyone to the main forum location for the concluding general recommendations.

PANEL COMMENTATOR

FUNCTION: The panel commentator will elicit and transcribe the recommendations of the panelists that develop during the discussion of the pivotal questions. Tese recommendations will be assimilated with those of other panels and read by the forum commentator in the open meeting.

Guidelines for Panel Commentators:

a. A consensus of opinion should develop after a reasonable time (approximately 15 minutes), and the panel commentator must now signal the end of discussion time for the question or be given the floor by the chairperson. At this time, the panel commentator should elicit the recommendations and compile a list to be shared with the other panels.

b. The recommendations should be:
   - Specific — not generalizations
   - Clear
   - A representation of a consensus of opinion
   - At a designated time and place all the Panel Commentators for a particular issue will meet with the Forum Commentators. Be prepared to give the recommendations to the Forum Commentator for your topic and assist him/her in compiling the recommendations.

PANEL RECORDER

FUNCTION: To be responsible for recording all of the information discussed by the panel.

Guidelines for Panel Recorder:

a. The Panel Recorder's job is the most exacting in the entire panel. He or she must record or take the minutes of the entire panel discussion.

b. The Panel Recorder must be able to identify a panelist who made a statement or posed a question. It would help to make a numbered chart with names to identify people.

c. It is most important that the recorder be accurate and clear in his note taking.

d. A tape recorder is recommended to fill in portions of notes and insure accuracy.

3. Committee Roles

Some students may be assigned to select committees to help in organizing and running the forum. Student committees may be responsible for placing display materials in the forum room, ushering invited guests to the various panels, registering invited guests and assisting in providing refreshments.

NOTE: *All students in the forum should have at least one specific task to perform.*

The following examples from a Science Forum illustrate possible committee responsibilities and functions. These are meant as suggestions and will vary depending upon individual circumstances.

SIXTH ANNUAL SCIENCE FORUM 1982 HAZARDOUS WASTE

FORUM SUBCOMMITTEE

1. Your area is the 2 display areas on the first floor, the welcome sign at the door, and one large sign for each of the four schools.
2. Welcome Sign:
   a. This is the first thing people will see — make it attractive. It should say "Welcome to the Sixth Annual Science Forum — 1982".
   b. An easel would be the best method of displaying this sign.
3. Display Area:
   a. Thematic Poster should be taped to the brick wall just outside the forum room. The themes include: Hazardous Waste, Love Canal, Radioactive Waste, Aquifers, Acid Rain.
   b. You may set up a display table with miscellaneous papers, articles, etc.
4. After the luncheon, return to the Communication Building and remove all your materials from the building. You may place the materials on the registration table.
5. You can set up at 3:45 pm on Friday (May 7th).
6. ARRANGE FOR ROPING OFF THE FIRST ROW FOR GUESTS AND SPEAKERS. (SPECIAL)

ROOM SUBCOMMITTEE

1. There are a total of 15 rooms which must be set up. See the floor plans. There are 11 rooms on the 2nd floor of the Communications Building and 4 rooms on the first floor. Check the room numbers carefully.
2. Each room should have a circle of chairs totalling 14 in the center of the room. Additional chairs in the rooms should be placed neatly against the walls.
3. Set up the chairs at 3:45 on Friday, May 7th.
4. At 2:30 on the Forum day, return to the Buildings and rearrange the chairs to their original positions.

PANEL SUBCOMMITTEE

1. Your job is to prepare 15 posters to be taped outside each of the 15 rooms. Refer to the floor plans for the accurate locations.
2. Bring your own scotch tape, etc.
3. The posters should measure 40cm × 60cm and they should all be uniform.
4. Posters should include the panel number and letter, the title, and the room number. For example: Panel AQ1 Aquifers, Room 22.
5. Bring these posters at 8:00 am on May 8th, the day of the Forum.
6. Return to the rooms after the luncheon to remove all signs.

REGISTRATION SUBCOMMITTEE

1. You will have 3 six foot tables for the registration on the day of the forum. Bring paper tablecloths to cover the tables.
2. Prepare packages of materials using the brown envelopes. The materials will be available from Mr. Cusimano. These are to be given to each person entering the building.
3. Prepare badges for each person listed on the master list prior to the forum. Information should include: Name; Title; Panel #; Room #.
4. For those persons who do not appear on the master list:
   a. Prepare a badge (bring extras)
   b. Assign them to a panel of their choice, but try not to allow any panel to exceed 14
   c. Record their name, title, address, and panel number on the master list.
5. Be sure each person registers. Give them an envelope, a program (separately), and a badge, and a questionnaire.
6. Students should also receive literature from Wagner College.
7. Prepare 2 boxes: One labelled "WORKSHEETS" and the other "QUESTIONNAIRES"
8. One member of the subcommittee should remain at the registration table until 10:15. At this time, place the two boxes on the registration table.
9. Cordially remind student speakers to take first row seats at the forum.

USHER SUBCOMMITTEE

1. There are three critical areas that must be covered:
   a. outside the Communications Building at 9:00 am directing people to the registration tables.
   b. inside the Communications Building at 9:00 am directing people to the registrations tables.

c. outside the forum room at 10:35 directing people to either the second floor of the Communications Building or to the first floor rooms. Familiarize yourself with which panels are meeting in which room.

2. At 1:10, ushers should be placed outside the Communications Building to direct people to the Student Union for the Luncheon. Another student should be in the Student Union taking a COUNT OF THE NUMBERS OF PEOPLE ATTENDING THE LUNCHEON. Report this number to Mr. Halpern or Mr. Cusimano.

REFRESHMENT SUBCOMMITTEE

1. You are to assist the parents in setting up the refreshment tables and CLEAN UP following the forum/luncheon. Be available during all "refreshment" periods in the program.

HAZARDOUS WASTE

SUBCOMMITTEES:

Room Subcommittee
Laura Conigatti, Chair
Hugh Campbell
Clark Davis
John DiNatale
Alan Doctor
Andrew Koren
Roberta Trainor

Forum Subcommittee
Jeanne Bennett, Chair
Sue Betts
Jacqueline Braccia
Joanne Krebushevski
Kathy Loughery
Carolyn Miller
Alicia Sisk

Registration Subcommittee
Debra Friedman, Chair
Tracy Degan
Peggy Eng
Mike Hunter
Eva Popko
Marc Waldman

Refreshment Subcommittee
Justin Donlon, Chair
Charles Frankel
Carl Geffkin
Geraldine Price

Usher Subcommittee
Michael Antonas, Chair
Ken Dulski
Richard Ford
Tony Gulotta
Steve Hayward
Brigitte Korda
Steven Rinehouse

Panel Subcommittee
Phillip Mauro, Chair
William Bifulco
Michael Conroy
Luanne DeLuca
Kim Heming
William Lee

4. Inviting the Community.

Since the primary goal of the forum is to allow students to "test" some of the conclusions they have drawn from their research, it is essential that individuals with varied perspectives participate in the forum as outside panelists.

Suggestions for Recruitment of Outside Panelists:

- The forum date should be advertised in advance.
- Local parent groups are extremely receptive and willing to participate in the program.
- Local colleges and universities should be contacted for interested participants.
- Other schools and students should be invited to participate.
- Local organizations, including scientific institutions, government agencies, and special interest groups should be contacted.

OUTSIDE PANELISTS

- Knowledgeable Guests — i.e. Professionals, Scientists and Teachers
- General Public

FUNCTION: Is to fully participate by providing as much specific information as possible to the discussion of the pivotal questions and to assist in the formulation of the recommendations.

Guidelines for Outside Panelists:

a. By virtue of this being a panel, a complete discussion of the issues is required. Outside panelists have much to offer and are fully encouraged to assist the student panelists in the discussion of pivotal questions and forum recommendations. There is an expertise and experience quotient in the outside panelist that is invaluable and will enchance the level of discussion.

NOTE: The forum can be designed to fit a single class or multiple schools. The larger the program, the more structured the preparation and organization must be, but in any case, it should be *entirely student oriented. All students in the forum should have at least one specific task to perform.*

A COMPENDIUM OF ORGANIZATION AND ROLES TO BE USED IN THE FORUM

1. SAMPLE OF GENERAL DIRECTIONS FOR STUDENTS
2. SAMPLE OF PIVOTAL QUESTIONS FOR PANELS
3. SAMPLE OF PANEL ORGANIZATION
4. SAMPLE OF PANELS
5. SAMPLE OF SUBCOMMITTEE ORGANIZATION.
6. SAMPLE OF FLOOR PLAN FOR THE FORUM
7. SAMPLE OF ROOM ASSIGNMENT ORGANIZATION
8. WORKSHEETS — EACH SHOULD BE DUPLICATED
   - A. Forum Moderator
   - B. Keynote Speaker
   - C. Forum Speaker
   - D. Forum Commentators
   - E. Student Panelist
   - F. Panel Chairperson
   - G. Panel Co-Chairperson
   - H. Panel Commentator
   - I. Panel Recorder
   - J. Outside Panelist
   - K. Forum Subcommittee
   - L. Room Subcommittee
   - M. Panel Subcommittee
   - N. Registration Subcommittee
   - O. Usher Subcommittee
   - P. Refreshment Subcommittee

SAMPLE OF GENERAL DIRECTIONS FOR STUDENTS

STUDENT ASSIGNMENTS

Check this list carefully to determine the various roles you will assume for the forum. Read the entire booklet carefully to get an overall picture of the forum activities.

SPECIAL NOTES

* Each student will submit his or her completed role sheet at the conclusion of the forum.
* All students must be at the Communications Building of Wagner College no later than 8:00 A.M. on May 8th.
* All chairpersons of Subcommittees should begin working immediately with their groups to insure completion of assigned tasks.
* Support materials, research papers, etc. should be brought to the forum to support your discussion on the panel. This includes any correspondence you may have received.

OVERALL PROGRAM

9:30 — 10:00	Registration for Panels
10:00 — 10:30	General Session
Forum Moderator:	Christine Vento (St. Joseph Hill Academy)
Greetings:	Congressman Guy Molinari
Keynote Speaker:	Rebecca Fisk (Susan E. Wagner High School)

SAMPLE OF PIVOTAL QUESTIONS FOR PANELS

HAZARDOUS WASTE

1. What are the short and long term effects of hazardous wastes on living organisms?
2. How can hazardous materials be safely stored or disposed of in our society?
3. Who is responsible when someone contracts a disease or dies from hazardous waste exposure?
4. What would be the financial effect upon our country and the world community if hazardous chemicals were not used?

LOVE CANAL

1. How can wrong doing be assigned to industries if past government activities were inadequate?
2. What input should big business have in the formation of policy decision by government?
3. What safety requirements should be established for dump sites? What other alternatives are there?
4. Who should be responsible for conducting safety tests? Government, industry, private agencies?
5. What legal rights should the residents of Love Canal have?

ACID RAIN

1. How might the environment cope with acid rain naturally? What are the present and potential consequences of acid rain?
2. How can we determine if the benefits of pollution generating industries outweigh the risks?
3. Who enjoys the industrial activity which produces acid rain and who bears the consequences?
4. Who should pay for acid rain research and, if necessary, remedial action?

RADIOACTIVE WASTE

1. What are the effects on the biosphere of radioactive waste? How do radioactive wastes react with inorganic substances?
2. How should biomedical and nuclear wastes be handled? Who will bear the costs?
3. Besides the federal government, who else should have input into the burial sites?
4. Do we have an obligation to the future generations of our planet? Why didn't past generations have the same responsibilities that we share?

AQUIFERS

1. Who enjoys the immediate and long term benefits of ground water use and are these the same people who are likely to suffer the deleterious effects of contaminated water?
2. How could government prevent further contamination and implement clean-up programs? What has government done already?
3. What are the "safe" levels for various contaminants and how reliable are the established safe levels?
4. Where should money to accomplish testing, clean-up, restrictions, etc. come from?

SAMPLE OF PANEL ORGANIZATION

Hazardous Waste

Panel HW4 **CB 2** **Room 30**

Chair: Coleen Moclair
St. Joseph Hill Academy
Co-Chair: Michael Friedman
Port Richmond High School
Commentator: Marc Heighton
Curtis High School
Recorder: Jeanmarie Burroughs
New Dorp High School
Panelists: Steve Seneca
Mark Skevofilax
Donna Villanueva
Participants: Carol Germano
Anthony Guarino

Love Canal

Panel LC1 **CB 2** **Room 31**

Chair: Bo Kim
Tottenville High School
Co-Chair: Stephanie Seminara
St. Joseph Hill Academy
Commentator: Ann Pechaver
Curtis High School
Recorder: Kim Heming
Staten Island Academy
Panelists: Steven Antico
Sue Betts
Lisa Cortese
John DiNatale
Robin Merenda
Participants: Dr. Sidney Borowitz
Scott Murray
Jerry Resnick

Love Canal

Panel LC2 **CB 2** **Room 32**

Chair: Francis Perez
Curtis High School
Co-Chair: Debra Friedman
Susan E. Wagner High School
Commentator: Olive Goh
Tottenville High School
Recorder: Luanda Roguso
New Dorp High School
Panelists: Alan Doctor
Kathy Loughery
Carolyn Miller
Christa O'Connor
Christine Vento
Participants: Darren Friedman
Salvatore J. Monte
Dr. Bianca Rosenberg

Love Canal

Panel LC3 **CB 1** **Room CCF 1**

Chair Michele Traboscia
Susan E. Wagner High School
Co-Chair: Lance Austein
Port Richmond High School
Commentator: Ann Mary Olsen
St. Joseph Hill Academy
Recorder: Lynn Brown
Curtis High School
Panelists: Jacqueline Braccia
Marissa Brin
Hugh Campbell
Justin Donlon
Oscar F. Mandes
Participants: Dr. Paul Hirsch
Christine Stiering
James Vento

HAZARDOUS WASTE

AQUIFERS	*PANEL AQ1*	*PANEL AQ2*
CHAIR	Beth Boyle	Valerie Rice
CO-CHAIR	Denise Monte	William Lee
PANEL COMM.	Dominick Lobraico	Anne Cucco
RECORDER	Ellen McCarthy	Eileen Devenney
PANELIST	Mark DeMauro	Lucy Napolitano
	Andrew Koren	Mary Robinson
	Beth Ann Banks	Deborah Sarlls
	Ellen Schroeder	Alicia Sisk

ACID RAIN	*PANEL AR1*	*PANEL AR2*	*PANEL AR3*
CHAIR	Leslie Frazier	Anatol Rowland	Lee Yang
CO-CHAIR	Dorothy Cernara	Michael Conroy	Robert Cohen
PANEL COMM.	Cynthia Caracta	Laura Fox	Mark Samse
RECORDER	Cheryl Gottesfeld	Judy Weeks	Paul Katz
PANELIST	Marie Johnson	Peter Farrell	Michael Lindeman
	Yuk-Ting Wu	Roberta Trainor	Clark Davis
	Laura Conigatti	Ken Dulski	Richard Ford
	Jeannemarie Kearney	Brigitte Korda	Steven Rhinehouse
	Luanne DeLuca	Jeanne Bennett	Eugene Sorensen
	Randa Zagzoug	Charles Frankel	Lorraine LaManna
	Geraldine Price	Ann Nestor-Hubert	Peggy Eng

HAZARDOUS WASTE	*PANEL HW1*	*PANEL HW2*	*PANEL HW3*
CHAIR	Ralph Boekmann	Joshua Friedlander	Seth Waldman
CO-CHAIR	Steve Bockish	Chung Tseng	Steven Tabak
PANEL COMM.	Bridget Beers	Andrea Cooper	Andrea Mohan
RECORDER	Anne Lamberti	China Ladner	Cathy Guiga
PANELIST	Kim Singletary	Stephen Farkough	Louise Seeley
	Dwayne Sims	Philip Mauro	Anne Marie Stilwell
	Alexander Wildmoser	Joanne Krebushevski	Meng Kao Tseng
	Rosa Cafasso	Ethan Mass	

HAZARDOUS WASTE	*PANEL HW4*
CHAIR	Coleen Moclair
CO-CHAIR	Michael Friedman
PANEL COMM.	Marc Heighton
RECORDER	Jeanmarie Burroughs
PANELIST	Steve Seneca
	Donna Villanueva
	Mark Skevofilax

SUBCOMMITTEES:

Room Subcommittee
Laura Conigatti, Chair
Hugh Campbell
Clark Davis
John DiNatale
Alan Doctor
Andrew Koren
Roberta Trainor

Forum Subcommittee
Jeanne Bennett, Chair
Sue Betts
Jacqueline Braccia
Joanne Krebushevski
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Mike Hunter
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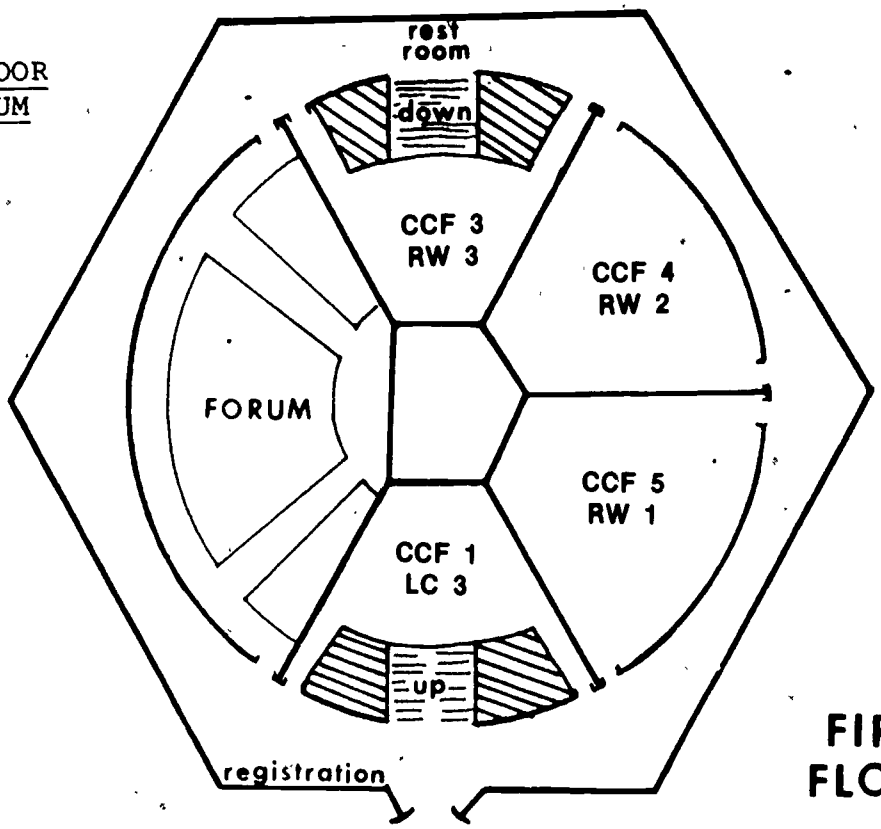
Charles Frankel
Carl Geffkin
Geraldine Price

Usher Subcommittee
Michael Antonas, Chair
Ken Dulski
Richard Ford
Tony Gulotta
Steve Hayward
Brigitte Korda
Steven Rinehouse

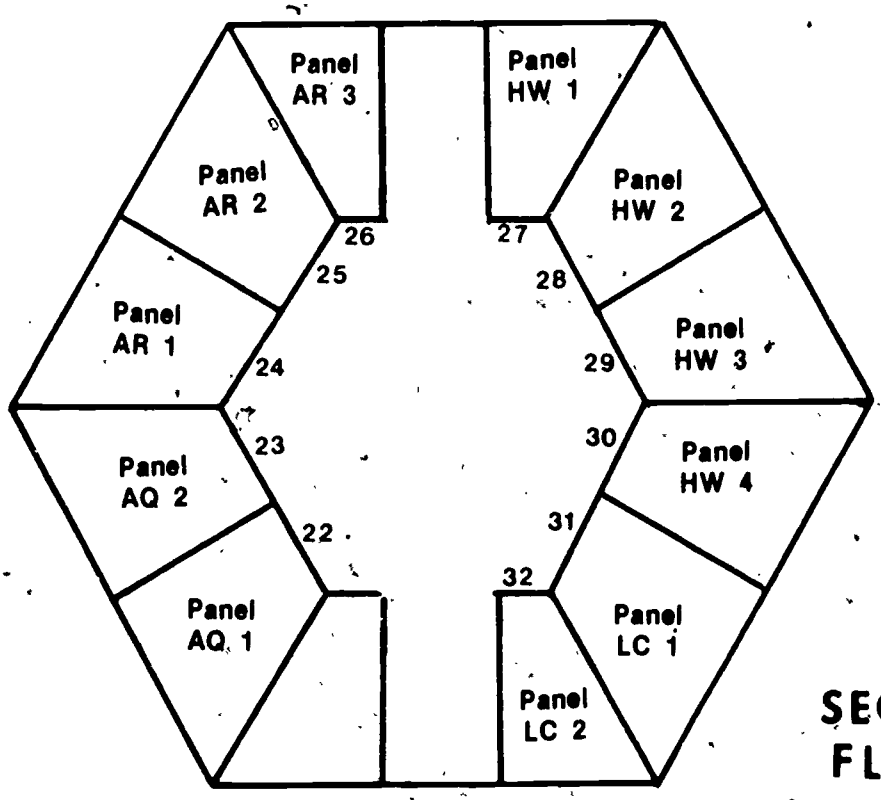
Panel Subcommittee
Phillip Mauro, Chair
William Bifulco
Michael Conroy
Luanne DeLuca
Kim Heming
William Lee

SAMPLE OF FLOOR PLAN FOR FORUM



FIRST FLOOR

COMMUNICATIONS BUILDING



SECOND FLOOR

Special Assignments for:

FORUM COMMENTATORS
PANEL COMMENTATORS

All Panel Commentators and Forum Commentators will meet in the rooms according to the schedule below at EXACTLY 12:25. Your work must be completed by 12:45. Return immediately to the Forum room at this time.

AQUIFERS — *Room 22*

Forum Commentator:	Beth Ann Banks
Panel Commentators:	Dominick Lobraico
	Anne Cucco

ACID RAIN — *Room 23*

Forum Commentator:	Eugene Sorenson
Panel Commentators:	Cynthia Caracta
	Laura Fox
	Mark Samse

HAZARDOUS WASTE — *Room 24*

Forum Commentator:	Steven Tabak
Panel Commentators:	Bridget Beers
	Andrea Cooper
	Andrea Mohan
	Marc Heighton

LOVE CANAL — *Room 25*

Forum Commentator:	Mitchell Traboscia
Panel Commentators:	Ann Pechaver
	Olive Goh
	Ann Mary Olsen

RADIOACTIVE WASTE — *Room 28*

Forum Commentator:	Amy Goldman
Panel Commentators:	Anita Jerome
	Marc Waldman
	Warren Katz

SCIENCE FORUM WORKSHEET

FORUM MODERATOR

1. *FUNCTION* : The moderator's job will be to control the movement of the entire forum.
2. *Guidelines for Forum Moderator:*
   a. *Welcome Address* — The welcome address should include:
      1. Who you are and the name of your school.
      2. Special thanks to sponsors.
      3. A few words about why we are here and the importance of this dialogue today.
   b. *Introduction of the Speakers:*
      1. Keynote Speaker
      2. Guest Speakers
      3. Forum Speakers

      The moderator should introduce the speakers one at a time by name, position, school and topic.
   c. *Direct the Audience to the Assigned Rooms*
      After the forum speakers have completed their talks, the audience must be directed to their assigned rooms for panel discussions. Advise the audience of the time to return to the forum room after the conclusion of the panel.
   d. *Introduction of the Forum Commentators*
      After the panels have returned to the forum room introduce each of the forum commentators. Explain to the audience that these are the summaries of all the panel recommendations within each topic that was prepared during the intermission after the panels ended.
   e. *Conclusion*
      1. Remind the audience to place questionnaires and worksheets in the boxes provided.
      2. Thank all the participants in the forum.
3. *Notes*
   a. Consult with your teacher and director regarding timing of the program and last minute additions and deletions. You should clearly advise the audience of where they should be at particular times of day.
   b. Attach a copy of your address to this page and place it in the box labelled "Worksheets" at the conclusion of the forum.

SCIENCE FORUM WORKSHEET

KEYNOTE SPEAKER

1. *FUNCTION:* The Keynote speaker will present speech to the general forum highlighting the principal issues that will be discussed.
2. *Guidelines for the Keynote Speaker*
   a. Meet with the panel chairmen at least two weeks before the forum to get an overview of what each issue covers.
   b. Prepare a 2–3 minute speech (500–750 words) that includes a motivating introduction and highlights the issues we will discuss. Do not get too specific since forum speakers will follow with particulars.
   c. Present your speech to the director for approval at least one week in advance of the forum.
   d. Speak slowly and clearly using pauses and eye contact for effect.
3. *Note*
   Attach a copy of your address to this page and place it in the box labelled "Worksheets" at the conclusion of the forum.

SCIENCE FORUM WORKSHEET

FORUM SPEAKER

1. *FUNCTION:* To raise the questions on your issue and suggest what the panels should examine. This is neither a personal viewpoint nor a criticism of others.
2. *Guidelines for Forum Speakers:*
   a. Meet with members of your assigned panel and discuss the main issues that will be reviewed. Get a consensus and prepare a speech to cover these points.
   b. The address will be exactly two minutes (approximately 500 words) and start with an attention getting, interesting introduction.
   c. Present the speech to the director at least one week before the forum for approval.
   d. Speak slowly and clearly using notes if necessary and maintain eye contact.
   e. Pause after important statements to allow for audience assimilation and emphasis.
3. *Note*
   Attach a copy of your address to this page and place it in the box labelled "Worksheets" at the conclusion of the forum.

SCIENCE FORUM WORKSHEET

FORUM COMMENTATORS

1. *FUNCTION:* To compile all the recommendations of the respective panels and produce one list to present to the forum.
2. *Guidelines for Forum Commentator:*
   a. Directly after the panels end meet with the Panel Commentators for your topic in designated room locations.
   b. Each Panel Commentator will have his/her own list of recommendations which you will compile into one list.
   c. Be careful not to repeat recommendations.
   d. Simplify recommendations so they can be presented as statements.
   e. Note and explain any disagreements between panels.
   f. You must be in the main forum lecture room 20 minutes after the end of the panel discussions prepared to report to the forum the compiled list of recommendations.
   g. You will be introduced by the Forum Moderator and have exactly two minutes to make your report. Identify yourself as "Forum Commentator for Topic . . . . "
   h. Speak slowly and clearly using pauses and eye contact to emphasize your statements.
3. *Note*
   Attach a copy of your address to this page and place it in the box labelled "Worksheet" at the conclusion of the forum.

SCIENCE FORUM WORKSHEET

STUDENT PANELISTS

Student Panelists are those students who are part of the forum program and have researched their chosen area of concern. This group will include students who have an additional function such as Forum Commentator and Panel Chairperson.

1. *FUNCTION:* The function of the Student Panelist is to bring his or her research into the panel discussion.
2. *Guidelines for Student Panelists:*
   a. Each student panelist, including those students with an additional function, will take two minutes (approximately 500 words) at the beginning of the panel to discuss the topic, procedures, findings and conclusions of his research. This will delineate areas of student strength and insure a highlighted gamut of all the students' research.
   b. All students will be expected to participate in the discussion of the pivotal questions and assist in the formulation of recommendations for future study.
   c. Cite as many specific references in the discussion to lend support to a position.
   d. Index cards can be used as sources of information during discussion.
   e. Your panel will be comprised of students like yourself and outside individuals with or without scientific expertise. Do not be apprehensive about these individuals as they wish to be constructive and will assist in formulating recommendations.
3. *Note*
   Place your comments and this sheet in the box labelled "Worksheets" at the conclusion of the forum.

SCIENCE FORUM WORKSHEET

PANEL CHAIRPERSON

1. *FUNCTION:* The Chairperson is responsible for the welcome, introduction, movement, direction and progress of the panel. He or she should offer the determined pivotal questions, moderate discussion, call on volunteer panelists and assist in every way.
2. *Guidelines for Chairperson:*
   a. Meet with your Co-Chairperson beforehand and clarify your role and how it will be shaped.
      Provide for a welcome that includes:
      1. The name of the panel.
      2. Introduction of student and guest panelists.
      3. Introduction of chairperson, co-chairperson, recorder and commentator.
   c. Provide an understanding of the function of the panel.
      1. Definition of a panel.
      2. Composition of the panel — students and guests.
      3. The procedure the panel will use. A discussion of pivotal questions through research papers and developed expertise will result in recommendations for future study.
      4. Pause for questions.
   d. Have each *student panelist* including those with additional duties give a two minute presentation that discusses the topic, procedures, findings and conclusions of his or her particular research paper. This should familiarize all panelists with the scope of the research and establish a place from which to start.
   e. Read the first pivotal question to the entire panel and generate discussion using the student researchers and guests. You must insure that:
      1. All panelists are given the opportunity to speak if they wish.
      2. Only one person speaks at a time. Do not allow one person to monopolize the conversation.
      3. The discussion does not stray from the topic.
      4. A consensus of opinion develops after a reasonable time and recommendations are set before going on to the next question (allow about fifteen minutes per question). This is accomplished by the *Panel Commentator* who is called

upon by the Chairperson when discussion ends or who concludes the discussion himself when the allotted time for the question elapses.

f. Continue to discuss each pivotal question in the same way with both you and the Co-Chairperson sharing the responsibilities.

g. Make note of the time and conclude when the allocated time expires.

h. Make any concluding statements and thank all participants. Direct everyone to the main forum located for concluding general recommendations.

3. *Note*

Attach a copy of your questions and recommendations to this page and place it in the box labelled "Worksheets" at the conclusion of the forum.

SCIENCE FORUM WORKSHEET

PANEL CO-CHAIRPERSON

1. *FUNCTION:* To assist the Chairperson in the welcome, introduction, movement, direction and progress of the panel. He or she should offer the determined pivotal questions, moderate discussion, call on volunteer panelists and assist in every way.
2. *Guidelines for Co-Chairperson:*
   a. Read and understand the worksheet issued to the Chairperson. You are equally responsible for the function of the panel.
   b. Meet with your Chairperson to discuss how the panel will be run.
   c. Your Panel Commentator will handle the recommendations at the conclusion of each discussed question (approximately 15 minutes).
   d. Help to formulate at least five additional questions that will help the panel focus on the issue.
3. *Note*
   Attach a copy of your questions and recommendations to this page and place it in the box labelled "Worksheets" at the conclusion of the forum.

SCIENCE FORUM WORKSHEET

PANEL COMMENTATOR

1. *FUNCTION:* The Panel Commentator will elicit and transcribe the recommendations of the panelists that develop during the discussion of the pivotal questions. These recommendations will be assimilated with those of other panels and read by the Forum Commentator in the open meeting.
2. *Guidelines for Panel Commentator:*
   a. A consensus of opinion should develop after a reasonable time (approximately 15 minutes) and the Panel Commentator must now signal the end of discussion time for the question or be given the floor by the Chairperson. At this time the Panel Commentator should elicit the recommendations and compile a list to be shared with the other panels.
   b. The recommendations should be:
      1. Specific — not generalizations
      2. Clear
      3. A consensus of opinion
      4. Accurate
   c. At a designated time and place all the *Panel Commentators* for a particular issue will meet with the *Forum Commentators*. Be prepared to give the recommendations to the *Forum Commentator* for your topic and assist him/her in compiling the recommendations.
3. *Note*
   Attach a copy of your compiled recommendations and place it in the box labelled "Worksheets" at the conclusion of the forum.

SCIENCE FORUM WORKSHEET

PANEL RECORDER

1. *FUNCTION:* The Panel Recorder will be responsible for recording all of the information discussed by the panel.
2. *Guidelines for Panel Recorder:*
   a. Your job is the most exacting in the entire panel. You must record and take the minutes of the entire panel discussion.
   b. You must be able to identify a panelist who made a statement or posed a question. It would help to make a numbered chart with names to identify people.
   c. It is most important that you are accurate and clear in your note taking and record as closely as possible what has actually been said.
   d. A tape recorder is recommended to fill in portions of your notes and insure accuracy.
3. *Note*
   a. *Mail one complete copy* of your notes to your director within two weeks.
   b. Place this sheet in the box labelled "Worksheets" at the conclusion of the forum. Place any comments on the back of the form.

SCIENCE FORUM WORKSHEET

OUTSIDE PANELISTS

1. *FUNCTION:* The function of the Outside Panelist is to participate fully by providing as much specific information as possible to the discussion of the pivotal questions and assist in the formulation of the recommendations.
2. *Guidelines for Outside Panelists:*
   a. By virtue of this being a panel, a complete discussion of the issues is required. Outside panelists have much to offer and are fully encouraged to assist the Student Panelists in the discussion of pivotal questions and form recommendations. There is an expertise and experience quotient in the Outside Panelist that is invaluable and will enhance the level of discussion.
3. *Note*
   Place your comments and this sheet in the box labelled "Worksheets" at the conclusion of the forum.

SUBCOMMITTEES

Some students may be assigned to select committees to help in organizing and running the forum. Student committees may be responsible for placing display materials in the forum room, ushering invited guests to the various panels, registering invited guests and assisting in providing refreshments.

The following sample worksheets are designed to help give direction to those student subcommittees. They are included to illustrate the structure of subcommittees and should be modified as the need dictates.

SCIENCE FORUM WORKSHEET

FORUM SUBCOMMITTEE

1. Your area is the 2 display areas on the first floor, the welcome sign at the door, and one large sign for each of the four schools.
2. Welcome Sign:
   a. This is the first thing people will see—make it attractive. It should say "Welcome to the Sixth Annual Science Forum—1982."
   b. An easel would be the best method of displaying this sign.
3. Display Area:
   a. Thematic Posters should be taped to the brick wall just outside the forum room. The themes include: Hazardous Waste, Love Canal, Radioactive Waste, Aquifers, Acid Rain.
   b. You may set up a display table with miscellaneous papers, articles, etc.
4. After the luncheon, return to the Communication Building and remove all your materials from the building. You may place the materials on the registration table.
5. You can set up at 3:45 pm on Friday (May 7th).
6. ARRANGE FOR ROPING OFF THE FIRST ROW FOR GUESTS AND SPEAKERS. (SPECIAL)
7. Place your comments and this sheet in the box labelled "Worksheets" at the conclusion of the forum.

Student's Name:

SCIENCE FORUM WORKSHEET

ROOM SUBCOMMITTEE

1. There are a total of 15 rooms which must be set up. See the floor plans. There are 11 rooms on the 2nd floor of the Communications Building and 4 rooms on the first floor. Check the room numbers carefully.
2. Each room should have a circle of chairs totalling 14 in the center of the room. Additional chairs in the rooms should be placed neatly against the walls.
3. Set up the chairs at 3:45 on Friday, May 7th.
4. At 2:30 on the Forum day, return to the buildings and rearrange the chairs to their original position.
5. Place your comments and this sheet in the box labelled "Worksheets" at the conclusion of the forum.

Student's Name:

SCIENCE FORUM WORKSHEET

PANEL SUBCOMMITTEE

1. Your job is to prepare 15 posters to be taped outside each of the 15 rooms. Refer to the floor plans for the accurate locations.
2. Bring your own scotch tape, etc.
3. The posters should measure 40 cm × 60 cm and they should all be uniform.
4. Posters should include the panel number and letter, the title, and the room number. For example: Panel AQ1 Aquifers, Room 22.
5. Bring these posters at 8:00 am on May 8th, the day of Forum.
6. Return to the rooms after the luncheon to remove all signs.
7. Place your comments and this sheet in the box labelled "Worksheets" at the conclusion of the forum.

Student's Name:

SCIENCE FORUM WORKSHEET

REGISTRATION SUBCOMMITTEE

1. You will have 3 six foot tables for the registration on the day of the forum. Bring paper tablecloths to cover the tables.
2. Prepare packages of materials using the brown envelopes. The materials will be available from Mr. Cusimano. These are to be given to each person entering the building.
3. Prepare badges for each person listed on the master list prior to the forum. Information should include: Name; Title; Panel #; Room #.
4. For those persons who do not appear on the master list:
   a. Prepare a badge (bring extras).
   b. Assign them to a panel of their choice, but try not to allow any panel to exceed 14.
   c. Record their name, title, address, and panel number on the master list.
5. Be sure each person registers. Give everyone an envelope, a program (separately), a badge, and a questionnaire.
6. Students should also receive literature from Wagner College.
7. Prepare 2 boxes: One labelled "WORKSHEETS" and the other "QUESTIONNAIRES".
8. One member of the subcommittee should remain at the registration table until 10:15. At this time, place the two boxes on the registration table.
9. Cordially remind student speakers to take first row seats at the forum.
10. Place your comments and this sheet in the box labelled "Worksheets and other Questionnaires" at the conclusion of the forum.

Student's Name:

SCIENCE FORUM WORKSHEET

USHER SUBCOMMITTEE

1. There are three critical areas that must be covered:
   a. Outside the Communications Building at 9:00 am directing people to the registration tables.
   b. Inside the Communications Building at 9:00 am directing people to the registration tables.
   c. Outside the forum room at 10:35 directing people to either the second floor of the Communications Building or to the first floor rooms. Familiarize yourself with which panels are meeting in which room.
2. At 1:10, ushers should be placed outside the Communications Building to direct people to the Student Union for the luncheon. Another student should be in the Student Union taking a COUNT OF THE NUMBERS OF PEOPLE ATTENDING THE LUNCHEON.
3. Place your comments and this sheet in the box labelled "Worksheets" at the conclusion of the forum.

Student's Name:

SCIENCE FORUM WORKSHEET

REFRESHMENT SUBCOMMITTEE

1. You are to assist the parents in setting up the refreshment tables and CLEAN UP following the forum/luncheon. Be available during all "refreshment" periods in the program.
2. Place your comments and this sheet in the box labelled "Worksheets" at the conclusion of the forum.

Student's Name:

SECTION IV: ADVISORY GROUP

PURPOSE

An advisory group can be extremely helpful in three ways:

1. Assist in the selection of topics. This will insure student that the issues selected are current and meaningful. If an advisory group is used in this way, the teacher is not confined to the issues presented in this manual, and the issues can be local issues reflecting the needs and interests of the community. For example, local waste disposal sites might be one issue for research.
2. A balance of views and suggested research strategies can be presented to the students if many segments of the community are represented on the advisory board.
3. Many reference materials can be suggested by the group in order to provide students with a good starting point for their research. A carefully selected advisory group can provide a wealth of starting materials for the students throughout their research.

WHO SHOULD BELONG TO THE ADVISORY BOARD?

The wider the representation of all segments of the community, the more effective the group. The ideal advisory group will have representatives from the scientific community, the academic community (including college and high schools), students, industry, parents, and government. Frequently, these groups are more than willing to help.

TIMING

The group should meet in June in preparation for program implementation in September. This provides ample opportunity for issue selection, feedback, and preparation of guidelines for student research in September. An additional meeting in the following early May or June will help to provide input on the effectiveness of the program and will often lead to concrete suggestions for the future.

SECTION V: RESOURCE CENTER

PURPOSE

A resource center for teacher and student use can be an invaluable asset to the program. Since many of the reference materials may be very specific and students may have difficulties in locating them, a central resource bank becomes important.

Such a center may contain vertical files of newspaper clippings, reprinted articles, government publications, newsletters, and correspondence. The center can also house select AV materials, periodicals, journals and books. A listing of some publications and materials can be found in Appendix II. When filing and indexing of materials becomes difficult, a micro-computer can be employed to assist students in locating materials. Students can be responsible for placing the citations in the computer file or even for preparing abstracts for the file.

LOCATION

As determined by the individual needs of the program, there are several ways in which a center can be established.

1. *Part of the center may be the existing school library.* School libraries can provide one small section of the library for students' use of selected materials for their research. Librarians are helpful in locating these materials, placing the materials in one section, and even providing library lessons on the use of the library. Where funds are available, the librarian can purchase special books and journals and provide updated lists to the students. Students can be assigned to assist the librarian.
2. *Many colleges and universities* are willing to allow students to use their library facilities. Contacts should be made with these institutions.
3. *A central location* may be selected outside the school setting. Local educational organizations and consortia may have facilities already in place to assist in setting up the center.

SECTION VI: PAPER REVIEWS

PURPOSE

It is extremely rewarding to students to have their papers read and reviewed by other individuals. Since they have spent a considerable amount of time in preparing the paper, they feel a sense of reward and accomplishment when someone takes an interest in what they have to say. In addition, comments made by reviewers directly on student papers establish a dialogue that the student can relate to on a personal basis.

Some Suggestions:

- Papers that are reviewed should be typed. This makes it easier for the reviewer.
- Scientists and other experts in the field of research can be obtained by contacting local colleges or professional organizations. If the number of papers and page limitations are kept to a minimum, these reviewers will do a better job and will be willing to volunteer again.
- Reviewers need guidelines on what you expect them to do. Do you want them to give their own opinions on the student's point of view, comment on writing skills and format, rate the papers on some scale, etc.? The primary goal of the review process should be increasing the variety of input a student will receive on his/her point of view.
- Some reviewers may be accustomed to professional papers only. In this case their comments may be extremely critical. It would be advisable to warn the students and to remind the reviewers of the level of sophistication of the students.
- Writing skills are always a problem. The *Writing Manual* should be used by all students. It is also advisable to have the papers reviewed by English teachers prior to review by scientists. This will provide students with an opportunity to revise their writing.

  English teachers can be involved in the process by encouraging cooperation with science teachers. Some of the topics of the program can be assigned by the English teacher as an "extra credit" report for selected students. Since the topics are applicable to all disciplines and subject areas, this is a natural enrichment activity for other students.

- Grading is always difficult since it may interfere with the intent of the review process. In addition, the evaluation of paper content is extremely subjective considering the complexity of the issues being researched. It is recommended that papers be graded on writing and format only. Some guidelines might be: proper reference style; grammar and punctuation; and acceptable format. Additional guidelines might include the presentation of a balanced argument, or the consultation of balanced reference materials. These may be subjective decisions, however.

SECTION VII: COMMUNITY INVOLVEMENT

RATIONALE

Since contemporary scientific issues have implications for all segments of society, the program would begin to address the need for community involvement. Parents and other community members become interested in the real issues that students are researching, and they express an interest and desire to know about the program as well as the issues.

Some Suggestions:

- The program can be presented to parent groups such as parent teacher associations.
- The community can be invited to attend the special lectures.
- The community should be invited to participate in the forum.
- A course can be offered in the adult education division of the local school.
- Community members can be used to disseminate information or to serve on advisory boards, as resources personnel.
- Community includes industry, colleges and universities, government agencies, educational organizations, parents and other teachers and administrators.

SECTION VIII: BUSINESS EDUCATION/ INDUSTRIAL ARTS

RATIONALE

The multidisciplinary nature of CIIS can be fully realized when additional classes and subjects participate in various aspects of the program. This also provides non-science students of all academic levels with an opportunity to become more aware of contemporary issues utilizing their own special skills.

Some Suggestions:

- *Business Education classes* can be assigned tasks such as recording class discussions (stenography), transcribing notes (transcription), and preparing final reports (typing). A glossary of scientific terms can also be prepared for use in the classes so students will be prepared and will also learn some new words. The use of word processors can further build on the experience of these students.
- *Industrial Arts classes* can be used to design program booklets, posters, displays, and announcements of lectures. Transcriptions of panel discussions or lectures can also be developed by students.

SECTION IX: INTERNSHIPS/CAREER EDUCATION

RATIONALE

Many of the issues discussed and researched by students highlight different careers. This involves careers within the physical and natural sciences as well as careers in government, industry, journalism, and education.

Some Suggestions:

- Where possible, special lecturers can be used to highlight career opportunities relating to the issue.
- Part of the class discussion on an issue can focus on careers.
- With the involvement of different organizations, the ability to set up summer internship programs becomes a natural development. For example, scientific institutions might be willing to take a small number of volunteers to assist in research projects.

SECTION X: INTERDISCIPLINARY APPROACH

RATIONALE

Since most issues are multidisciplinary, it is feasible to implement CIIS within the social studies or English curriculum. The different modules of the program make this approach a logical sequence in the development of critical thinking skills in students.

Some Suggestions:

- The case studies in the *Course Manual* might be used individually at appropriate points within any existing curriculum.
- The issues presented in Appendix I might be incorporated in disciplines other than science.
- The writing techniques and activities in the *Writing Manual* are applicable to any subject.
- Many of the issues posed in the *Course Manual* can be used effectively in the social studies curriculum.

APPENDIX I—SOME ISSUES

ACID RAIN

I. OVERVIEW:

Rain—it has been the subject of countless songs and poems—and has provided a dramatic setting for plays and movies. Nothing seems more romantic than walking in the rain, or healthier than jogging in it. Man has hoped, prayed, and in some cultures, even danced, in an effort to summon needed rainfall. Recent studies, however, have indicated that the previously welcomed rain clouds may be depositing a subtle, slow-acting poison on portions of our planet. Due to the interaction between air pollutants and rainwater, the pH of the water which actually reaches the ground is significantly lower than normal. This kind of precipitation is commonly referred to as acid rain. Its effect on the environment is presently being researched by various organizations at a cost of $10 million a year.

II. BACKGROUND:

Normal rainwater is slightly acidic (pH 5.6) due to the conversion of atmospheric carbon dioxide to carbonic acid. This level of acidity is desirable because it allows certain soil minerals to dissolve and be utilized by organisms. The average pH of precipitation falling on northeastern United States, however, is less than 4.5, and this level is harmful. What factors produce this relatively high concentration of acid in rain water? The combustion of fossil fuels, such as coal and oil, releases 50 million metric tons of sulfur and nitrogen oxides into the air each year. In 1977, an estimated 26% of all air pollution was attributed to these nitrogen and sulfur oxides. Air pollution, however, is not the focus of our problem. Given the appropriate conditions (sunlight, humidity, ammonia, oxidation, etc.) these pollutants become oxidated. It is the product of this sulfuric and nitric acid, which is the major component causing acid rain.

What are the effects of acid rain? Are they serious enough to warrant our concern? Under the guidance of the E.P.A. and the Dept. of Agriculture, various organizations are conducting studies designed to explore the effects of acid rain. Initial interest was stimulated by the sudden failures of lakes in certain areas to support fish. For example, there are over 90 lakes in the

Adirondack Mountains which are devoid of trout and perch. These fish had originally abundantly populated some of the region. Apparently, the fish could not tolerate the 4.8 pH of the lake. Inhabitants of these lakes are threatened directly by the deviation from normal pH and indirectly by the release of toxic metals (mercury, aluminum, lead) from the lake bed. The latter is facilitated by the unnaturally low pH. Another symptom of acid rain may be the accelerated erosion of man made structures, such as the Statue of Liberty. Finally, how does acid rain affect forests and agriculture? Various crops have been experimentally treated with artificial acid rain in an effort to establish potential influence. Results have been diverse. Other studies have attributed the decline in white pine and quaking aspen populations to the increasing incidences of acid rain.

III. SOMETHING TO THINK ABOUT:

Is acid rain a problem or can its effects be dismissed as mere selective forces with which populations must cope within the course of evolution? If it is not a cause for immediate concern, can acid rain prove to be a threat in the future? It is likely that coal consumption will increase, particularly in the U.S. "Smoke stacks" are becoming more numerous and taller, which allows the products of coal combustion to remain in the air longer and be more widely dispersed. Will this increase the incidence, intensity, and range of acid rains? Often, the site of acid rain is miles from the source of the causal pollutants. For example, Sweden and Norway must bear the repercussions of industry in Germany and England. Should the inhabitants of these "fall-out" locations be compensated? If acid rain is a problem, whose responsibility should it be to solve it?

IV. QUESTIONS:

1. *Social*—Who enjoys the industrial activities which produce acid rain and who bears the consequences?
2. *Political*—If restriction on industrial areas, or compensation to "fall-out" areas is warranted, which of the involved governments should determine the nature of this balance? Why? How can the government(s) design and implement this program?
3. *Scientific*—How might the environment cope with acid rain naturally? What are the present and potential consequences of acid rain? What modes of generating energy do not involve fossil fuels?
4. *Moral/Ethical*—How can we establish if the benefits of pollution generating industry outweigh the repercussions of acid rain?
5. *Economic*—Who should pay for acid rain research and, if necessary, remedial action? How much money does present day research involve, and how does this compare with the price tag of tomorrow?

V. REFERENCES:

E.P.A. Office of Research and Development. *Acid Rain*. Washington, D.C.: U.S. Government Printing Office, July 1980.

LaBastille A. "Deadly Toll of Acid Rain: All of Nature Is Suffering." *Science Digest*, 86 (October 1979), pp. 61–66.

D'Antonio, Michael. "Banking on Coal to Solve Our Energy Woes." *Family Week*, 28 December 1980.

Zimmerman, Richard G, Amos A. Kevmisch. "The 80's Issue: Acid Rain Debate Heating Up." *Staten Island Advance*, 23 August 1981, p. A16.

Zimmerman, Richard G. "Foul Air From Ohio Brings Acid Rain to Adirondacks." *Staten Island Advance*, 24 August 1981, p. B1.

VI. NOTE TO TEACHER:

1. *Earth Science*—
   Acid rain is a major erosive force. Concept of pH.
2. *Chemistry*—
   The information and neutralization of acid serves as a study in acid/base reactions. The ability of acid rain to increase the concentration of ions in solution can be used to clarify ionization.
3. *Physics*—
   Atmospheric
   Transport and dispersion
   Mechanisms
   Meteorology

RADIOACTIVE WASTES

I. OVERVIEW:

In the 1920's female factory workers would dab a brush on their tongues for a fine tip while painting the hands of clocks and watches with luminous paint. This introduced the radioactive material, radium, into their bodies. Their incidence of death due to bone cancer was elevated beyond that of the average. United States uranium miners had an increased rate of lung cancer and deaths when exposed to radon gas in the mines.

Radioactive materials are used in medicine, in weaponry, and in the production of electricity in increasing quantities.

With our increased use of radioactive materials comes the problem of radioactive wastes. The importance of an effective, efficient, and permanent plan for the safe disposal of the radioactive wastes that are produced as a by-product of nuclear technology is evident.

II. BACKGROUND:

The potential dangers of radioactive wastes arise chiefly from the ionizing radiations that are emitted and the related health hazards. Natural radition in the U.S. is about 102 mrem or about 1/10 of a rem. This combined with other sources (medical, etc.) brings the U.S. average up to about 200 mrem. This is increased at higher altitudes.

For each metric ton (1,000 kilograms) of uranium, 800 million kilowatt-hours of electrical energy are produced. This figure does not include the production of other fissionable material, such as plutonium, neptunium, curium, and americum. In order to render the U.S. totally self-sufficient for electric energy from nuclear reactors, it is estimated that about 400 1,000 mega-watt nuclear power plants would be necessary. Each such plant would ultimately produce an amount of radioactive waste that would be about 2 cubic ft. per year.

The total radioactive waste output from just the production of electric power would yield about 800 cubic ft. per year. The annual cost of disposing the wastes from just one such reactor is estimated to be about $200 million. A total of $160 billion annually would be necessary for disposal of these wastes from the U.S. alone. Of course this analysis centers upon underground burial. There

are other proposals for nuclear waste deposits, such as undersea burial and deep space. It must also be noted that radioactive wastes are not buried immediately, but held for a time so that the shorter half-life wastes (I 131) could have a chance to decay. This leaves only the long-lived wastes, which must be stored in the interim.

III. SOMETHING TO THINK ABOUT:

How is an effective permanent waste management program developed? First, is a waste management program necessary? Consider that the naturally occurring amount of radioactivity from mineral deposits, such as uranium, thorium, potassium, and rubidium, is at present, greater than the reactor produced wastes. However, the reactor produced wastes are far more concentrated. We know radiation can cause cancers and genetic defects in pregnancy. We also know that low level radiation can re-unite broken chromosomes into a unified strand. Second, how permanent is "permanent"? Nuclear wastes must be isolated for hundreds of years. Most prevailing social and political institutions rarely experience this type of longevity, but planetary flora and fauna can.

Will the future generations be more highly technologically advanced than present societies and, therefore, be better equipped to deal with past buried wastes? What if they are less advanced? Should burial sites be marked so that future generations will be alerted to the danger. How do we mark these sites, assuming present day records might not be available? Will there ever be a need for these waste canisters to be recovered for new uses?

IV. QUESTIONS:

1. *Social*—Who is to decide on the guidelines for a waste disposal program? Scientists, businessmen, politicians, environmentalists, etc.? Who will represent the people? Can any one group be totally satisfied? Can all groups be totally satisfied?
2. *Political*--Are the present federally outlined guidelines adequate? Besides the federal government, who else should have input into the burial sites? Or should decisions be made on local, statewide, or international levels? Will the political use of foreign oil supplies lead the U.S. into premature guidelines? What input will power companies have considering the cost overhead for disposal?
3. *Scientific*—What are the effects on the biosphere of radioactive wastes? How do radioactive wastes react with inorganic substances? What are some of the effective half-lifes that apply? What should an effective disposal plan include to assure continued safety? How can we be certain that future geological occurrences will not alter the burial sites from safe to dangerous/lethal? How should biomedical and nuclear weapons wastes be handled?

4. *Moral/Ethical*—Do we have an obligation to the future generations of the planet Earth? Do we have a commitment to life in the universe? Why didn't past generations have the same responsibilities that we share?
5. *Economic*—In relationship to coal oriented electric power, the nuclear wastes incur a tremendous disposal cost. Who will bear the costs and is it feasible?

V. REFERENCES:

Cohen, Bernard L. "The Disposal of Radioactive Wastes from Fission Reactors." *Scientific American*, 236 (June 1977), pp. 18, 21–31.

Choppin, Gregory R. "Chemical Issues in Nuclear Wastes Disposal." *The Science Teacher* (Feb. 1981).

Reinhardt, W.G. "Nuclear Wastes: Where Do They Go?" *Sci Quest*, 53 (May/June 1980), pp. 12–17.

Carter, Luther J. "Congressional Committees Ponder Whether to Give States a Right of Veto over Radioactive Wastes Repositories." *Science*, 200 (9 June 1978), pp. 1135–1137.

Cohen, Bernard L. "The Cancer Risk from Low-Level Radiation," *Health Physics*, 39, Oct. 1981.

VI. NOTE TO TEACHER:

1. *Earth Science*—
   Environmental changes
   Terrestrial radiation
   Earth's water
   Geological events
   Natural radioactivity of minerals
2. *Chemistry*—
   Nuclear chemistry
   Atomic radiation
      Half-life
      Radioisotopes
3. *Physics*—
   Energy sources—electrical from nuclear
   Atomic accelerators
   Nuclear fission and fusion
   Atomic and subatomic particles and radiation

4. *Biology*—
   Genetics—mutations, DNA, mutagenic agents, chromosome breaks, carcinogens
   Pollution
   Biochemistry

VI. VOCABULARY:

rem
mrem
geiger counter
alpha rays
beta rays
gamma rays
x-rays
nuclear reactor
cyclotron

HAZARDOUS WASTES

I. OVERVIEW:

We are all members of a complex industrial society with a high standard of living that has resulted from scientific and technological advances. One of the prices we pay for these benefits is the production of many hazardous industrial and agricultural waste products. These hazardous wastes can be harmful to humans and to animals and plants. Some are immediately damaging or poisonous; others act over a long period of time causing things like cancer and birth defects.

The problem that faces us can be stated very simply. We depend on technology to maintain our lifestyle, but many of the by-products of our technology are detrimental to our lifestyle. How do we manage these hazardous wastes (by recycling or other means) to minimize their negative effects?

II. BACKGROUND:

A hazardous waste is an industrial by-product which, if it is released into the environment, can disrupt the food chain, damage or destroy plant life, harm humans directly, or otherwise degrade the environment (e.g., cause smog, cause erosion, etc.) The materials may be toxic, non-biodegradable, and bioaccumulative. DDT is a good example of a substance with all of these qualities. Because many hazardous wastes take years to be directly harmful, we are often not aware of their potential for damage until it is too late, as was the case with DDT and asbestos.

Because many effects of hazardous wastes are subtle and hard to detect over a long time, the task of identifying all hazardous wastes and determining how to handle them is a very long, slow job. The U.S. Environmental Protection Agency (EPA) has issued rules governing hazardous wastes defining a hazardous waste either as a specific substance by name, or a substance with certain specific properties. Under these regulations the number of hazardous waste substances is enormous and compliance is expensive. Many companies object to the expense and argue that many substances considered hazardous are not. Thus, legal battles and arguments cloud the issue and postpone a true solution.

III. SOMETHING TO THINK ABOUT:

When a person commits a crime, we can punish the individual and force him to pay his debt to society. When a company unintentionally produces a hazardous material as a by-product in a manufacturing process that benefits mankind who is to blame? It can be realistically argued that without the use of these materials millions of people who benefit from the activity of pesticides would lack the food to survive. What are the viable options open to an industrial society that assumes the responsibilities of feeding much of the world? In our society we like a right and a wrong way for all decisions and dislike a gray colored area that has no definitive answers. Are chemical companies heroes or scapegoats? Is the American public guilty of expecting too much from our society and painfully blind and "Moralistic" when we realize the price we must pay for the abundance?

IV. QUESTIONS:

1. *Social*—What are the social implications of the presence of hazardous wastes in a community? How are different ethnic groups affected by their exposure to hazardous chemicals in their employment: What would the world effect be of cutting the use of hazardous material in agriculture?
2. *Political*—Why are politicians often involved in hazardous waste controversies? How should the politics of hazardous waste problems be changed? What are the responsiblities of our politicians to the community in which they serve regarding hazardous materials? What are the political effects of finding hazardous wastes in a community?
3. *Scientific*—What are the short and long term effects of hazardous wastes in living organisms? How could hazardous wastes change the living community? What protection can we produce for organisms that are exposed to hazardous wastes? How can hazardous materials be safely stored or disposed of in our society?
4. *Moral/Ethical*—Why are moral and ethical labels difficult to assign when we speak of hazardous wastes? With our knowledge of hazardous chemicals, does the end result of feeding the world justify the use of these chemicals? Are other uses of hazardous chemicals ever justified? Who is responsible when someone dies due to hazardous chemical exposure? Should chemical companies pay large settlements when someone is hurt by hazardous chemicals that are manufactured by that company?
5. *Economic*—What would be the financial effect on our country if hazardous chemicals were not used? What would be the financial effect on the world if hazardous chemicals were not used? How are communities economically affected when hazardous materials are found in their air, soil or water?

V. REFERENCES:

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VI. NOTE TO TEACHER:

1. *Earth Science*—
   Environmental change
   Pollution topic (artificial-natural)
   Pollution deposit rates
2. *Chemistry*—
   Organic chemistry and inorganic
   Chemical structure
   Formula
   Effects
   pH, acid, base
   Hydrolysis (if any)
3. *Biology*—
   Ecology, food chains
   Genetics, mutation, disease
   Physiology

VII. VOCABULARY:

PCB
PBB
trichloroethylene
ethyl chloride
mutagen
carcinogen
teratogen

LOVE CANAL

I. OVERVIEW:

The Declaration of Independence states that all citizens have the rights to life, liberty and the pursuit of happiness. However, to 1,000 families living in a quiet section of New York State, near Niagara Falls, known as the Love Canal, happiness is a thing of the past, and fear is a constant companion. Not the fear of crime or fire, but the fear that many of them are walking time bombs. People were uprooted from their homes and cast about at the discretion of political jockeying for funds. Hopelessly, they waited for answers that had to come from the slow American legal process; knowing all the while that each one of them has the high potential to develop cancer or a myriad of other medical disorders; knowing that pregnant women had a higher rate of miscarriages than the natural average; and, knowing that the newborns show a higher risk of birth defects.

Between the years 1947 and 1952, 21,800 tons of chemicals were dumped in the area of the Love Canal by Hooker Chemicals, which is now a subsidiary of Occidental Petroleum Corporation. In 1953, Hooker Chemicals sold the Love Canal site to the Niagara School Board for $1.00 with a disclaimer of responsibility for any future effects that the buried wastes may cause. Not only was a school built, but the remaining land was sold to a land developer for the purpose of building homes.

II. BACKGROUND:

A toxic substance is any material that is poisonous to animals and man. This adverse effect can be temporary, causing rashes, burns or simple poisoning. The effects can also be prolonged, such as in lung disease or cancer. We all live with constant exposure to some toxic elements. Three such common substances are lead, caffeine, and diesel exhaust. In addition to these toxic substances, and those that are the products of a highly technological society, another source is the unmanaged dumping of hazardous wastes.

Approximately 4,000 people lived in the Love Canal. Coincidence was attributed to the high incidence of miscarriages, cancer and other frequent disorders that plagued the 1,000 families until 1976, when, after several years of heavy rains, poorly disposed toxic chemicals came percolating up the surface, and the Environmental Protection Agency (EPA) conducted tests. These tests concluded

that 82 various uncommon compounds were in houses, basements and yards; eleven of these were carcinogenic. The first warning came in the form of an evacuation notice for pregnant women and children under the age of two. Later the EPA conducted chromosome tests, which lead to a greater controversy as far as procedure and significance of results. The tests indicated that 11 out of a total of 36 people tested exhibited some amount of chromosome damage. On May 21, 1980, President Carter declared the Love Canal in a state of emergency and cleared the way for relocation of the remaining 2,500 residents. A multi-million dollar suit against the Hooker Chemicals Company was initiated by the EPA. Untold bureaucratic snafus resulted. The Love Canal families were caught in the middle between state and federal governments. The Love Canal has erupted into a legal case, setting precedents and causing the formation of various laws.

III. SOMETHING TO THINK ABOUT:

A highly technological society requires the use of complex chemical substances to keep the general standard of living high. Pesticides are necessary in agriculture to yield greater crop production. Fertilizers increase land productivity. Most chemicals are believed to be relatively safe under "normal conditions of use." However, in some cases improper use can have drastic results, as in the case of Agent Orange. Who is to be responsible for the misuse or improper handling of potentially harmful substances? One basic tenet permeates throughout: As long as toxic substances are used, the effective and safe use and disposal of these substances must be a primary consideration to not add to the existing health hazards.

IV. QUESTIONS:

1. *Social*—Who will be responsible for establishing regulations? How will the laws be enforced? If past regulations were not adequate, how can we be certain that present policies will stand the test of time?
2. *Political*—What input should big business have in the formation of policy decisions by government? Can states and localities impose laws that supercede federal laws: Should they? Should an international policy be formulated? How will this affect less advanced countries?
3. *Scientific*—How should tests on chemicals be conducted? Should everything be tested, and, if so, who should be responsible for conducting the tests— government, industry, private agency? What are the criteria for testing? Are tests limited to carcinogenic materials? What safe requirements should be established for dump sites? What other alternatives are there? How accurate can diagnostic testing really be?
4. *Moral/Ethical*—How can wrong-doing be assigned to industries? What obligation should we have in the export of hazardous wastes? Should the business faction be totally responsible for past dumping practices? Are they obligated to the public and to what degree?

5. *Economic*—Can present industries withstand the high cost of complying with governmental rules and regulations? Is it economically feasible to clean a dump site? What other alternatives are there? Should funding be one group's total responsibility or should it be shared by both business and government?

V. REFERENCES:

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VI. NOTE TO TEACHER:

1. *Earth Science*—
   Erosion process
   Earth's water
2. *Chemistry*—
   Organic chemistry
   Carcinogenic substances
3. *Biology*—
   Genetics
   Ecology—pollution
   Biochemistry
   Human pathology—carcinogens

VII. VOCABULARY:

trichloroethylene (TCE)
vinylchloride
curene 442
polychlorinated biphenyls (PCB)
TRRS
polybrominated biphenyls (PBB)
carcinogen
mutagen
teratogen

AQUIFERS

I. OVERVIEW:

Four-fifths of our planet's surface is occupied by water, but you can't see most of the earth's fresh water. Ninety-seven percent of our fresh water is located underground where it accumulates naturally in reservoirs referred to as aquifers. This sub-surface water has many names such as ground water, spring water, well water, mineral water, and, if it has bubbles, Perrier. Ground water results from the seepage of surface water (from lakes or precipitation), down through permeable soil until it reaches a level of saturation, referred to as the water table. It is capable of "flowing", but its movement is much slower than that of surface water, such as a river, and is measured in mere feet per year. Why does this underground water supply, which is at least temporarily removed from the traditional evaporation-condensation-precipitation water cycle, warrant our attention? Twenty-five percent of the fresh water used in industry, in agriculture and for drinking is obtained from this underground source. Furthermore, the use of ground water had increased from 1950–1975 by more than 140% and will probably continue to do so, in response to man's increasing demands on our natural resources. Recent investigation, however, has indicated the presence of pollutants in many aquifers—an assault on nature which is proving difficult to arrest and potentially impossible to reverse.

II. BACKGROUND:

Historically, ground water has been considered the purest water, a reputation which at first glance is justified. As tiny droplets of water percolate through soil particles, they become cleansed via a physical process (filtration), a chemical process (absorption), and a biological process by the ecological intervention of microbes. Certain pollutants, however, are immune to this natural cleaning process either because of their particular chemistry or because of the excessive quantities present. Once the tainted water reaches the level of the water table, it may remain there indefinitely or seep to other aquifers. Further natural cleaning does not occur at the level of saturation where conditions are abiotic. Tests have indicated the presence of toxic organic and inorganic chemicals in drinking water extracted from underground wells. Particularly worrisome are the levels of chlorinated hydrocarbons which were observed, because these do not occur in nature (as do some of the heavy metals, such as zinc), and they are harmful in very low concentrations. (Anything greater than 10 parts per billion is considered hazardous.)

Chlorinated hydrocarbons are odorless and tasteless. They may be potentially mutagenic and carcinogenic, and their effects are unpredictable. Low dosage exposure over an extended period of time may produce a cumulative effect, and interaction with other compounds at "safe" levels may produce deleterious effects. Finally, the establishment of safe or non-risk levels is a subject of considerable debate and inconsistency.

Assuming that contamination of ground water is a problem, what courses of remedial and preventative action are feasible? Cleanup techniques are inconvenient and expensive because of the location of ground water. Ascertaining the extent and location of contamination is also difficult because ground water movement is erratic and hidden from view. According to the E.P.A. (1977) *Report to the Congress on Waste Disposal Practices and their Effect on Ground Water*, industrial impoundments and landfills are the greatest contributors to ground water pollution. Secondary sources are municipal waste water, mining, petroleum production, and septic tanks.

III. SOMETHING TO THINK ABOUT:

Water—the ultimate cure-all. In an age when the air is dirty and noisy, and foods contain steroids, nitrates, and other questionable additives, water is the last frontier. This is verified by the bottled water business which is enjoying a recent surge. Water can be purchased with natural bubbles or synthetic ones, domestic or imported for drinking and even spraying on one's face! In spite of our dependence on it, many have risked a type of contamination which can travel underground to every portion of this planet, which can exert its effects at very low, undefined dosages, and which may be difficult to remedy once it has reached the water table. Whatever course of action man pursues, one thing is undeniable—our ground water supplies are in grave danger.

IV. QUESTIONS:

1. *Social*—Who enjoys the immediate and long-term benefits of ground water use and are these the same people who are likely to suffer the deleterious effects of contaminated water?
2. *Political*—How could government prevent further contamination and implement clean-up program? What has government done already?
3. *Scientific*—What are the "safe" levels for various contaminants and how reliable are the established safe levels?
4. *Moral/Ethical*—Who should have the right to answer 1, 2, and 3. Why?
5. *Economic*—Where should money to accomplish testing, restricting, clean-up, etc. come from?

V. REFERENCES:

Molotsky, Irvin, "House Panel Lists Toxic Sites Threatening Water Supplies in U.S." *New York Times*, 28 September 1980, p. 45.

Ambroggi, Robert P. "Underground Reservoirs to Control the Water Cycle." *Scientific America*, 236 (May 1977), pp. 21–27.

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VI. NOTE TO TEACHER

1. *Earth Science—*
   The concept of an aquifer can be used to explain the origin of artesian wells, geysers and springs. Ground water accumulation can be related to soil permeability and precipitation. The presence of ground water illustrates how water can temporarily "escape" the water cycle.
2. *Chemistry—*
   The concept of chemical equilibrium in nature can be demonstrated by tracing the ionic concentration in ground water at various depths as it percolates from the surface. One of the most commonly detected contaminants in ground water is the chlorinated hydrocarbons.
3. *Biology—*
   Contamination of aquifers can be used to illustrate the need for ecological awareness. The positive effect of soil bacteria, which does not occur at the water table, can also be mentioned during the unit on ecology. The potentially carcinogenic or mutagenic effects of the contaminants serve as a supplement for modern genetics.

CLONING

I. OVERVIEW:

"If I could only do it over, I would . . . ." Everyone has probably begun a sentence similar to this one. People wonder how their present situation might have been altered had they pursued different courses of action, such as staying in school or being less frugal. They lament over the truth of the adage, "Youth is wasted on the young." Considering recent research, however, the fantasy of starting one's life over, *with* the advantage of experience, is becoming a viable possibility. Cloning is a process which is capable of generating a new organism which is genetically identical to its "parent" or donor. Essentially the clone would have the same starting material as the donor, but by virtue of the donor's experience, could avoid all the pitfalls of the latter's life. Although the successful cloning of a human has never been documented, the basic procedures which have been utilized to clone other organisms, theoretically, apply to man.

II. BACKGROUND:

The term clone is derived from the Greek word *klon* which means twig. Those who enjoy a green thumb are probably familiar with the capacity of cells in leaves, stems, or twigs to differentiate and produce whole plants. These resulting plants are genetically identical to the original and any observed differences can be attributed to environmental influences. The current concept of a clone is similar in that the resulting organism is a genetic xerox of the donor. According to recent research, however, the donor need only relinquish a single cell.

In 1960, Steward of Cornell University cloned a carrot plant. In 1968, Gurdon of Oxford University cloned a frog! His classic experiment involved the extraction of a nucleus from a frog's intestinal cell (theoretically, any diploid nucleus from any somatic cell would be suitable.) This nucleus was subsequently implanted into a frog ovum which had been treated with ultra-violet light. The ultra-violet light served to destroy the haploid nucleus already present in the ovum. The resulting structure contained the stored "food" material necessary for cleavage, and the chromosomes required to dictate differentiation. Given time, a carbon copy frog was produced. Extending Gurdon's techniques to mammals would require that the manipulated ovum be implanted into a uterus for gestation.

III. SOMETHING TO THINK ABOUT:

In His Image: The Cloning of a Man, was written by Borvik and published in 1978, by Lippincott, as non-fiction. It related the unsubstantiated story of a rich man's living clone. To date, there is no proof that a human clone exists, and cloning techniques are utilized mainly for cancer research—not asexual reproduction. If we dismiss the cloning of people as immoral or impossible, we can reap the benefits of this technique, using other oganisms. Man could mass produce countless copies of favorable genes, which might appear as a result of sexual reproduction. Sterile animals, such as the mule, would enjoy new-found reproductive capacity. Finally, in experiments involving animals, countless variables could be eliminated by utilizing only organisms which were clones of the same donor.

IV. QUESTIONS:

1. *Social*—Where would a human clone "fit" in the family scheme? How would this unique position affect his or her psychological development?
2. *Political*—Who would determine the rights of a human clone? Who would be responsible for donor selection?
3. Scientific—What is the relationship between the genetic starting material in a clone and the environmentally modified result? How could man, as a species, cope with the stunted evolution inherent in asexual reproduction? What are some scientific uses of cloning apart from human cloning?
4. *Moral/Ethical*—What rights would a clone be entitled to? What criteria would determine the selection of donors? At what stage of the cloning process is a clone considered to be alive?
5. *Economic*—What price tag should a clone warrant? What is the value of life? What should be the cost of the procedure?

V. REFERENCES:

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VI. NOTE TO TEACHER:

1. *Biology—*
   The implications of cloning provide an excellent motivation for a discussion of the environment's influence on genotypic expression.

   The cloning technique provides a practical example of uses of microdissection apparatus.

   Cloning is a dramatic example of artificial asexual reproduction and provides a clarifying contrast to parthenogenesis.

   The ability of a diploid nucleus to initiate and direct cleavage and differentiation can be used to illustrate:

   A. Functions of the nucleus in directing cytoplasmic activities

   B. Function of the nucleus as containing genetic materials

   The need for an ovum verifies the role of the "stored food" in female gametes.

VII. VOCABULARY:

haploid (monoploid) versus diploid
gamete
somatic

RECOMBINANT D.N.A.

I. OVERVIEW:

Exposure to mutagenic agents, such as the ultraviolet light emitted by the sun, results in the production of faulty replication and subsequently cell division. Safeguarding the integrity of the genetic material is the capacity of D.N.A. to excise and digest the offending segment and replace it with a copy of the original. This editing and reconstruction process can be artificially induced so that the introduction of foreign D.N.A. fragments (those extracted from another kind of organism) will result in the creation of novel, hybrid. D.N.A. The presence of this D.N.A. confers upon its possessor talents which are not typical of the species. It is referred to as recombinant D.N.A.

II. BACKGROUND:

Public apprehension was elicited by the implications of genetic engineering. Suppose the genes of normally harmless bacteria were spliced with the genetic instructions from another oganism which coded for the production of toxins. Further speculation revealed the possibility that bacteria which were sensitive to antibiotics might become resistant as a result of recombinant D.N.A. Proposed experiments utilizing the cancer causing SV 40 virus aroused public fears. Man is not directly endangered by the virus which usually affects monkeys. The hazards lie in the fact that viral D.N.A. was being combined with the D.N.A. of E. Coli—a bacterial inhabitant of our digestive tract, to which we are highly receptive. What if these bacterial, modified by a cancer gene, were to escape. Even favorable recombinants, whose potential value to society was obvious, came under attack. For example, G.E. had created a microbe which possessed the genetic blueprints to "eat" oil spills. Our ecological gold mine, however, could prove to be an economic disaster if these organisms were to escape into fuel supplies. Biology will have extended its boundaries to a point where even our cars could get an infection!

Scientists' recognition of the potential biohazards of genetic engineering motivated a series of self-scrutinizing conferences. This awareness was formally demonstrated at the Gordon Research Conference on Nucleic Acids in 1973 during which scientists wrote an open letter to *Science*, stressing caution. The following year, discussions at the Massachusetts Institute of Technology induced Berg (known for his SV 40 virus studies) to advocate a voluntary moratorium on ge-

netic engineering within the scientific community. At the 1975 Asilomar Conference, scientists voted to self-regulate recombinant D.N.A. experiments, and finally in 1976, the N.I.H., (National Institute of Health) designed and implemented a formal set of safety guidelines. These, however, were either relaxed or eliminated in 1978.

III. SOMETHING TO THINK ABOUT:

In spite of initial hesitancy, which ranged from wariness to panic, genetic engineering has endured. In fact, this new frontier in biology may prove to be a profitable venture in business. The notion of utilizing recombinants as chemical factories capable of synthesizing insulin, vitamins, or the clotting factor has stimulated the inception of such corporations as Genetech (1976), Genex (1977), and Biogen (1978). Several companies are seeking patents for their "original" organisms. Do they have a right to claim, as their own, a reshuffled product of nature? A more altruistic avenue of genetic engineering centers on the possibility of utilizing recombinant D.N.A. to make interferon. This virus fighting substance occurs naturally in man and may be used to cure many diseases—probably even cancer.

IV. QUESTIONS:

1. *Social*—Who might benefit or suffer from the results of recombinant D.N.A. research? What information does the public require (and how can it be made available) to make logical, valid decisions regarding genetics engineering?
2. *Political*—How can the government design and implement regulatory guidelines?
3. *Scientific*—What are the benefits and risks associated with genetic engineering?
4. *Moral/Ethical*—What is the relationship between pure scientific inquiry and potential dangers to safety?
5. *Economic*—Should recombinant products be patented? Should recombinant techniques be patented?

V. REFERENCES:

Marx, Jean L. "New Clues to Cancer's Causes." *New York Times Magazine*, November 1979.

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"Politics and Genes." *Newsweek*, January 1976.

"Court Says Lab-Made Life Can Be Patented?" *Science*, June 1980.

"Recombinant D.N.A. Warming up for Big Payoff" *Science*, 206. November 1979.

VI. NOTE TO TEACHER:

1. *Physics*—
   The need for negative air pressure in P3 and P4 contaminants serves as a practical example of gas laws.
2. *Biology*—
   Recombinant D.N.A. techniques and products illustrate the following:
   a. transformation
   b. transduction
   c. the distinction between pathogenic and non-pathogenic bacteria
   d. genetics—role of virus and plasmids
      —gene role in coding for enzymes
      —enzyme role in cells
      —replication and cell division
      —relationship between genotype and phenotype
3. *Ecology*—
   The repercussions of artificially broadening an organism's ecological niche (for example the oil eating microbes) illustrates the importance of a balance in nature.

VII. VOCABULARY:

dimer
virus versus bacterium
plasmid

ORGAN TRANSPLANTS

I. OVERVIEW:

Every day numerous people voluntarily permit technicians to remove a pint of their blood. This quantity of blood will be used some time later for transfusions, usually into some unknown person. What has been established here is a liquid tissue transplant. Most of us find no moral or religious objections to this type of medical procedure. The medico-legal aspects here are limited. At times large scale blood drives are organized and conducted. At times people have been known to have sold their blood.There presently exist blood banks and eye banks.

In the novel *Coma* the need for organs and tissues for transplantation became the subject of unethical business practices. People went into a hospital for routine medical treatments and a state of coma was induced. The required organs were then put up for sale to the highest bidder. In reality the selection of a living donor involves medical decisions, psychological considerations, and family interactions. The rights of donors have been spelled out in the Uniformed Anatomical Gift Act of 1968. However, each state determines to what extent this act is to be followed and to which organs it will apply.

II. BACKGROUND:

Transplanted parts replace diseased, damaged, or destroyed body parts. The medical community transplants tissues, such as blood, blood vessels, bones, skin and corneas. The organs that can be transplanted are hearts, kidneys, livers, lungs and pancreases. There exist two types of donors. The first are live donors who voluntarily choose to donate an organ, usually a kidney or bone marrow to another person. The recipient is generally a close relative. The compatibility of a transplant is determined by tissue typing. The closer the donor and recipient are genetically, the increased rate of success.

About 20% of all transplants fall into this first category. However, a donor is not permitted to give an organ solely on the basis of tissue typing. Other social, ethical, and pyschological factors must be taken into consideration. The second type of donor represents a person who recently died or whose death is imminent. Herein lies an important issue. The concept of death is one that has been disputed in both the medical and legal communities. How is the definition of death determined? Do surgeons wait for a person to die and upon command, like some gro-

~~esque~~ fiend, rapidly cut into that body so that another shall have the opportunity to remain alive?

Tissue compatibility is still a primary consideration even when the donor is non-related. Generally, the recipient must be administered drugs which reduce the effectiveness of the body's immune system. This, in itself, leads to increased susceptibility to disease. Nevertheless, these drugs probably are the greatest single reason why some types of transplants do meet with success.

III. SOMETHING TO THINK ABOUT:

What could be more self-satisfying than to know that by donating some part of your body or making preparations for future donations (donor cards, wills, etc.) you could help another human being? In another sense, some part of you could continue to live on after you have passed on. Psychoanalyst Roger Money Kryle once wrote, "The gift of life places one with the gods." However, can a living donor be pressured into giving an organ? What familial pressures may arise? How about the psychological aspects that must be faced by a live donor? What psychological problems might the recipient face? Even though the risks to live donors are minimal, all surgical procedures involve some risk and pain. Does a moral dilemma exist? If I donate one of my kidneys, and the other one malfunctions, what happens then?

IV. QUESTIONS:

1. *Social*—What legal aspects are involved? What about persons under the legal age? At the time of death how much duress is the next of kin under? Can clear decisions be made? Should issues involving transplants be unilaterally decreed?
2. *Scientific*—How is death determined? To what degree does the limited success rate in certain transplants enter into a doctor's decision? What emotional problems are faced by both the donor and the recipient?
3. *Moral/Ethical*—How do artificial techniques of prolonging life enter into the question of death and the decision making process? Who has the rights to a body: Family, medical community, wishes of the deceased? Are certain transplants worthwhile, considering the longevity of the recipient and the rejection factor?

V. REFERENCES:

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McCabe, Robert E., and Hugh F. Fitzpatrick. "The Preservation of Human Cadaver Kidneys for Transplantation." *JAMA*, February 1972.

VI. NOTE TO TEACHER:

1. *Biology—*
   antigen—antibody production
   immune systems
   biochemistry

VII. VOCABULARY:

antigens
antibodies
immunity

LAETRILE

I. OVERVIEW:

In a 1920 attempt to improve the flavor of his bootleg whiskey, Dr. Ernst Krebs isolated a substance which seems to discourage tumor growth in rats. In 1952, his son purified this apricot pit derivative, claimed that it could cure cancer, and named it laetrile. An emotion-charged, controversial debate ensued and is still in progress: Is laetrile effective in the treatment of cancer? The F.D.A., supported by many scientists, denies the positive effects of laetrile and fears that public preoccupation with this pseudo-cure can delay or replace conventional cancer treatments. Laetrile proponents extol the virtues of the drug, insisting it has saved countless lives or at least postponed death in cancer victims. Since pro-laetrile organi ations have failed to secure F.D.A. approval, restrictions have been placed on its use.

II. BACKGROUND:

Laetrile contains a substance which releases cyanide as a by-product of its reaction with betaglucosidase. According to Ernst Krebs, Jr., refiner of the original apricot pit extract, cancer cells contain more of this betaglucosidase enzyme than normal cells, and thus become targets of cyanide poisoning. Actual test results have indicated, however, that higher concentrations of betaglucosidase occur in normal cells. Another theory which seeks to explain laetrile's unsubstantiated positive effects states that cancer is produced by a deficiency of vitamin B12, which amygdalin replenishes. Among the claimed beneficial effects of laetrile are increased appetite, reduced pain, a general sense of well being, cancer remission, and ultimately—cure. Encouraged by these pro-laetrile allegations, thousands of people trek to Mexico seeking laetrile therapy. Treatment would be much more economical if government restrictions had not been imposed. On what basis does the F.D.A. oppose legal sanctioning of laetrile therapy?

Surveys have indicated that 65% of Americans fear cancer more than any other hazards. There are 700,000 cases of cancer diagnosed each year and two of every three people who are initially affected will eventually die of the dreaded disease in spite of corrective surgery, chemotherapy, and radiation therapy. It would be a gross understatement to say that America was merely receptive to the idea of a "natural" cure for cancer. Laetrile appears to be such a cure. It comes from fruit pits and it is administered in conjunction with a "health" diet. Perhaps

the mood of the country is responsible for laetrile's popularity because scientific testing of the drug's effectiveness has indicated that it does not cure, prevent, or arrest cancer. Among the organizations who tested laetrile are the National Cancer Institute (5 tests conducted from 1957–1975), Sloan-Kettering in N.Y.C. (37 experiments from 1972–1976), and the Mexican Board of Health.

Positive results supposedly achieved through the use of laetrile are criticized for a variety of reasons. Among them are the placebo effect, lack of pathology reports and the use of laetrile simultaneously with conventional drugs. Another source of distortion is the tendency of cancer patients to exhibit spontaneous, temporary remission. If this occurs during laetrile treatment, hopeful patients naturally attribute the improvement to laetrile. In spite of the documented evidence against laetrile, battles to legalize its use persist. The media are flooded with case histories of people who were miraculously cured by laetrile.

III. SOMETHING TO THINK ABOUT:

The ultimate issue appears to be—not "Does laetrile cure cancer?"—but "Should people have a right to choose a particular treatment?" The Committee of Freedom of Choice in Cancer Treatment (CFCCT) believes that they do. Assuming that laetrile's benefits are purely superstitious, why shouldn't people enjoy the peace of mind its use might confer? Will people necessarily delay or eliminate traditional methods of cancer therapy in favor of laetrile treatment? If they do, the "lost" time might prove lethal. If laetrile therapy is merely a tonic for the mind and serves only to reduce a dying patient's mental anguish, should the presiding physician enjoy a profit? Doctors Richardson and Contreros banked a combined 4.5 million dollars over a 27 month laetrile treatment period. In the eyes of the government, they are criminals, but from the perspective of a terminal cancer patient, they might represent the last hope or the final disappointment.

IV. QUESTIONS:

1. *Social*—How can society evaluate a controversial commodity such as laetrile?
2. *Political*—Why should the government's influence and power extend into an area such as laetrile? Why shouldn't it?
3. *Scientific*—What are the physiological/psychological benefits/hazards of laetrile?
4. *Moral/Ethical*—What guidelines can be utilized to determine the amount of control a person has over his own fate?
5. *Economic*—Who should profit from laetrile therapy? Who should pay?

V. REFERENCES:

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"Laetrile—The Political Success of a Scientific Failure." *Consumer Reports*, August 1977.

Harper, Harold N., M.D. *Medical Freedom of Choice*, (Pamphlet).

American Cancer Society. *Cancer Quackery* (Pamphlet), 1977.

Cournand, Andre. "The Code of the Scientist and Its Relationship to Ethics." *Science*, November 1977.

VI. NOTE TO TEACHER:

1. *Biology*—The theory of how laetrile destroys cancer cells can be used to illustrate enzyme. The psychological impact on a person's health is demonstrated by laetrile's "effects" (i.e., the placebo effect).

VII. VOCABULARY:

amygdalin
placebo effect
vitamin B12

GENETIC COUNSELING

I. OVERVIEW:

The science of genetics is greatly dependent upon probability for the expression of traits. It is understood that we are an expression of the genetic constitution that we receive from our parents at the time of conception. The quantity as well as the quality of each chromosome (fragmentation, translocations, *etc.*) play an important part in our physical and mental makeup. Upon the chromosomes are genes which determine traits (eye color, skin pigmentation, height, *etc.*) The expression of these traits must take into account the environmental effects. Both the prenatal and postnatal environments must be considered (e.g. heroin or methadone mothers). Most pathological genetic research is centered on the ability for early diagnosis of potential or present defects. In a case of the presence of a potential defect, the parents could make, what would be hoped to be, any informed intelligent choice. The early ability to recognize inborn genetic errors as the cause of certain disorders has brought into the forefront genetic counseling. Even early screening of newborns can greatly affect the outcome of treatment (e.g. PKU). Our increased knowledge in this field, however, does not come without a price tag for both the parents and the medical community.

II. BACKGROUND:

Chromosomal and genetic research have lead to insights into a variety of physical and mental disorders. Many of these can be screened for in any one of three levels: pre-conception, pre-natal, and post-natal. The pre-conception level involves the concerned parents while still at the family planning stage. In this case the doctor who is conducting the test is looking for carriers of a specific trait (sickle cell anemia or Tay Sachs). In most cases a simple enzyme examination or a blood sample is sufficient when coupled with a family pedigree. The second type of screening procedure is during the pre-natal stage. This usually involves amniocentesis. Amniocentesis is usually performed only with prior cause (family trends or a frequency of spontaneous abortions). The third type of screening is post-natal. This can involve tissue culturing or blood-enzyme testing. The follow-up procedure involves a meeting with a genetic counselor who will explain to the parents all potential risks or treatments that would be followed. In any case, the ultimate decision is up to the parents. This can be one of deep moral, social, familial, and even economic judgment.

If pre-conception testing indicates a potential problem, the choice to the parents is relatively simple. Should reproduction be desired, then they must take into account the potential risk factors. This leads to the second stage for pre-natal evaluation. The dilemma arises only if the fetus tests out to be affected with the disorder. Is abortion recommended or feasible from a variety of moral viewpoints? If abortion is rejected, then what treatments can begin pre-natally or post-natally if there are therapeutic measures available? At this time the parents must also contend with any economic aspects of future care and what social/medical services are available. The same problems arise if newborn screening is the first indication of a disorder. The role of the genetic counselor does not only end after an accurate decision has been made. The counselor must not only be an advisor, he must take into account psychological, social, and even familial stresses.

III. SOMETHING TO THINK ABOUT:

Genetic screening should be a very favorable and positive aspect of family planning. However, as the scientific abilities and accuracies increase, certain problems will intensify. At what point should a doctor advise for screening? Who should be told the results in addition to the parents? Should screening be conducted "en masse"? Could mass screening lead to "typing" of people or groups? How will advances in genetic screening affect the abortion rate? Should screening be done for disorders where there is no treatment? Could either the cost factor for screening and/or treatment ever be prohibitive? Should screening for sex (boy or girl) be permitted? There is a prevailing mood that screening should not be conducted for trivial purposes. The main purpose of all types of diagnostic procedures is to reduce the number of birth defects and/or to begin therapeutic measures early. This is admirable in terms of minimizing human suffering. However, are we heading for "A Brave New World"? The establishment of a sperm bank for Nobel Prize Winners has even been proposed by some. Maybe we should not be too quick to abort fetuses. Each developing fetus has a future life potential. A man with maiformed hands or diabetes still has the potential to be a great educator, scientist or philosopher. A paralytic can be a pianist, artist or world leader. It is obvious that criteria for screening should be established.

IV. QUESTIONS:

1. *Social* — What limitations to screening should be imposed? Who should establish any controls? Could screening advance lead to selective marriages? Could we be establishing a genetic class system? How can "genetic equality" be maintained among social groups?
2. *Political* — What political implications can arise from genetic screening? What about mass screening of various cultures?
3. *Scientific* — What is involved in the counseling aspects? What related medical services should be provided? What psychological effects could screening cause to a carrier? Should treatments be more important than testing procedure advances?

4. *Moral/Ethical* — Should we interfere with "God's Will"? Should the screening results be private or part of public or other records? Could advances in screening and bioengineering lead to a "perfect" society?

V. REFERENCES:

Lappe, Marc. "Humanizing the Genetic Enterprise." *Hastings Center Report*, Dec. 1979.

Marx, Jean, L. "Restriction Enzymes: Parental Diagnosis of Genetic Disease." *Science*, July 1975.

Culliton, Barbara. "Genetic Screening: MAS Recommends Proceeding with Caution." *Science*, July 1975.

Dorfman, Albert. "Genetic Nos: Its Significances for the Practicing Physician." *Prism*.

Leff, David, M. "Boy or Girl: Now Choice, Not Chance." *Medical World News*, Dec. 1975.

VI. NOTE TO TEACHER:

1. *Biology*—
genetics, biochemical genetics

VII. VOCABULARY:

fragmentation of chromosomes
translocation
PKU
pulverization of chromosomes
karyotype

BIRTH CONTROL

I. OVERVIEW:

A lemming is a small mouse-like creature. As legend has it, every few years millions of these plump little creatures march to the sea and commit mass suicide. An inherent time clock is built in this rodent society. The existence of the species can not be maintained when the population is greater than the food supply. The lemming is an example of the success of the species being supreme over the individual. Survival of a species contending for limited food is also given as a possible reason for the spontaneous beaching of certain whales. Most animal societies operate in a delicate balance in response to the available food supply coupled to the predator-prey relationship. This is how animal populations are kept in check and co-exist within a given environment. The population growth curve is represented by an S curve. The S curve represents ultimate balance within all factors. It is suggested that the world human population may also follow this pattern. In past decades, natural disasters (famine, flood, plague) and wars, kept check of population growth. Even with some of these pressures existing today, our world population is accelerating at a tremendous rate.

II. BACKGROUND:

In his "Essay on Principle of Population" (1978), Thomas R. Malthus contended that populations tend to increase more rapidly than food supplies. It's believed that disease and wars would have to reduce the population unless people decide to limit their number of children. However, in Malthus's "Second Fixed Law of Nature", he provides for procreation without restraint or what is commonly known as "reproductive freedom." Almost two centuries have passed, and world hunger is probably the single most important problem facing this planet today. To correct the problem of world starvation, either a mass increase in food production is necessary or a serious attempt must be made to decrease the rapid birth rate. The technology is not readily present to have any feasible effect on global food production. Limiting the birth rate seems to be the only viable solution if human life on this planet is to continue into future centuries. We can, of course, refuse to acknowledge any problem and patiently wait for some great catastrophe to solve the problem temporarily.

The humane solution for this overcrowded world seems to be a determined program of birth control. However, not all methods of birth control are feasible in all situations. Besides abstinence, the only method of birth control that is

virtually 100% effective in preventing conception, is the surgical modification of the productive organs. In many areas of the world surgery may be the only method that is feasible due to various problems of economics, social taboos, public education, and, most important, willingness to comply. This is not taking into account any moral objections that some societies and religions have to restricting reproductive freedom.

III. SOMETHING TO THINK ABOUT:

Do the affluent nations of the world owe any obligation at all to the poorer countries? For years the rich countries have been providing food and fertilizers and technological assistance to the poorer ones. It is only natural to want to try to help alleviate poverty, starvation and disease. After over 30 years of aid, the mortality rates have decreased with an increase in the birth rate. Maybe part of our aid should have included contraceptive devices to the poorer countries. Is a policy of total non-intervention callous and inhuman? Some countries have started their own birth control policies. However, some of their programs were not as effective as may have been hoped, and some compulsory measures have been implemented. Does a national program of birth control interfere with a person's reproductive freedom, or is the society, or even mankind, more important than the individual should a society be compelled into the choice, or should the choice be left to the individual? The question of "voluntarism" becomes paramount. There are economic, moral and religious aspects involved in decision making. Does society have the rights or even the ability to reduce reproductive potential? What about eugenics as an aspect of sterilization? The overall question of the society and mankind and their chances of continued survival in an over crowded world is foremost.

IV. QUESTIONS:

1. *Social* — Should society dictate principles of birth control including sterilization? Should highly technological nations accept or share responsibility for newly emerging nations? How does free reign enter into a discussion? Should legislation against or for birth control be imposed? Can it be enforced? How? Are war, pestilence, and famine acceptable alternatives to birth control?
2. *Political* — Are nations where overpopulation and limited food resources exist open to more political instability? Should birth control policies be overviewed universally? Could sterilization be used to establish a one class system for political gain?
3. *Scientific* — What are the various methods of birth control and how effective are they? What biologically related problems do the birth control methods incur? What medical services must be rendered for an on-going policy of birth control? Is zero population growth scientifically feasible?
4. *Moral/Ethical* — What moral, ethical, cultural, or religious objections are there to birth control, either on an individual or nationwide level? What restrictions of freedom would a policy of birth control impose?

5. *Economic* — Which methods of birth control are the most cost effective? What economic restrictions would be incurred in a long range national birth control policy? Does the decrease of population outweigh any cost? Which economic aspect will be the most limiting in a successful project?

V. REFERENCES:

Petchesky, Rosalind P. "Reproduction, Ethics, and Public Policy: The Federal Sterilization Regulations." *Hastings Center Report*, Oct. 1979.

Murdoch, William W., Allen Oaten. "Population and Food. Metaphors and the Reality." *Bio Science*. Sept. 1975.

Hardin, Gassett. "Living on a Lifeboat." *Bio Science*. Oct. 1974.

Gulhati, Kaval. "Compulsory Sterilization: The Change in India's Population Policy." *Science*. March 1977.

Culliton, Barbara. "Birth Control — Report Argues New Leads Are Neglected." *Science*. Nov. 1976.

VI. NOTE TO TEACHER:

1. *Biology*—
   reproduction — sexual; contraception
   ecology — predator — prey relationship; overpopulation
   population growth curves
   interpreting data

VII. VOCABULARY:

vasectomy
tubal ligation
hysterectomy

APPENDIX II: SOME SELECTED RESOURCES

ORGANIZATIONS

Center for Environmental Information, Inc. (33 South Washington Street, Rochester, New York 14608)

Worldwatch Institute (1776 Massachusetts Avenue N.W., Washington, D. C. 20036)

The Institute for the Study of Animal Problems (2100 L Street, Washingtion, D. C. 20037)

The American Society of Law and Medicine (520 Commonwealth Ave., Boston, Massachusetts 02215)

Institute of Environmental Sciences (940 East Northwest Highway, Mt. Prospect, Illinois 60056)

The Forum for the Advancement of Students in Science and Technology, Inc., (2030 M Street, Washington, D. C. 20036)

Institute for Scientific Information (3501 Market Street, University City Science Center, Philadelphia, Pa., 19104)

American Association for the Advancement of Science (1515 Massachusetts Avenue, N.W., Washington, D. C. 20005)

Some Available Publications:

Scientific and Engineering Societies
Resources for Career Planning
AAAS Science Book List
AAAS Compendium Series

Health Sciences Consortium (200 Eastowne Drive, Suite 213, Chapel Hill, N. C. 27514)

National Science Teachers Association (1742 Connecticut Ave., N.W., Washington, D. C. 20009)

Some Available Publications:

Energy-Environment Source Book
Environment: The Human Impact
Hunger: The World Food Crisis
Population Growth: The Human Dilemma

PERIODICALS

Crossroads — Science Meets Society (P.O. Box 465, Forest Park Station, Springfield, Massachusetts 01108)

Bulletin of the Atomic Scientists (1020-24 East 58th Street, Chicago, Illinois 60637)

The Human Life Review (The Human Life Foundation, Inc., 150 East 35th Street, New York, N. Y. 10016)

The Futurist (4916 St. Elmo Avenue, Washington, D. C. 20014)

Ethics in Science and Medicine (Pergamon Press, Inc., Fairview Park, Elmsford, N. Y. 10523)

Science, Technology, and Human Values (Aiken Computation Lab 234, Harvard University, Cambridge, Massachusetts 02138)

Solar Age (Church Hill, Harrisville, N. H. 03450)

High Technology (38 Commercial Wharf, Boston, Massachusetts 02110)

The Hastings Center Report (The Hastings Center, 360 Broadway, Hastings-On-Hudson, N. Y. 10706)

Scientific American (415 Madison Avenue, New York, N. Y. 10017)

Technology Review (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139)

Science (1515 Massachusetts Avenue, N.W., Washington, D. C. 20005)

Science 81 (1515 Massachusetts Avenue, N.W., Washington, D. C. 20005)

Science 82 (1515 Massachusetts Avenue, N.W., Washington, D. C. 20005)

Science, Technology, & Society (327 Maginnes Hall #9, Lehigh University, Bethlehem, Pennsylvania 18015)

AUDIOVISUAL MATERIALS

Science and Mankind, Inc. (Communications Park, Box 2000, Mount Kisco, N. Y. 10549)

Fisher Scientific Company (52 Fadem Road, Springfield, N. J. 07081)

American Chemical Society Audio Courses (1155 Sixteenth St., N.W., Washington, D. C. 20036)

Hawkhill Associates (125 E. Gilman Street, Madison, Wisconsin, 53791)

The Center for Humanities, Inc. (Communications Park, Box 100, White Plains, N. Y. 10602)

Prentice Hall Media (Servcode WC, 150 White Plains Road, Tarrytown, N. Y. 10591)

Guidance Associates (Communications Park, Box 300, White Plains, N. Y. 10602)

SPEAKER DIRECTORIES

1978-1979 Directory of Physics and Astronomy Staff

Members (American Institute of Physics, 335 E. 45th Street, New York, N. Y. 10017)

— contains addresses of 2,900 institutions and staff members and industrial and not-for-profit laboratories and staff

The Communicators (American Nuclear Society, 555 North Kensington Avenue, LaGrange Park Illinois 60525)

— a directory of energy-related speakers and contacts for the public and the media

History of Science Society Speakers Bureau (AAPT, Graduate Physics Building, State University of New York, Stony Brook, New York 11794)